08-320669 A

* NOTICES *

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2. **** shows the word which can not be translated.
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CLAIMS

[Claim(s)]
[Claim 1] The drive circuit of a capacitive load which impresses the pulse of positive/negative amphipathy to the capacitive load which has the 1st and 2nd electrodes characterized by providing the following by turns. The charge recovery circuit which delivers and receives a charge periodically between the 1st electrode of the above. The 1st clamping circuit which clamps the 1st electrode of the above to the 1st or 2nd predetermined potential in some [at least] periods other than the period of transfer of the aforementioned charge. The 2nd clamping circuit to which floating of the 2nd electrode of the above is carried out corresponding to the period of transfer of some aforementioned charges while clamping the 2nd electrode of the above to the 3rd or 4th predetermined potential.
[Claim 2] The predetermined potential of the above 1st and the 3rd predetermined potential are substantially equal, and the predetermined potential of the above 2nd and the 4th predetermined potential are the equal drive circuit of a capacitive load according to claim 1 substantially.
[Claim 3] The drive circuit of a capacitive load according to claim 1 or 2 where the aforementioned charge recovery circuit contains the capacitor for charge recovery, and a reactor.
[Claim 4] The drive circuit of a capacitive load according to claim 1 or 2 where the aforementioned charge recovery circuit is constituted as a circuit using the counter-electromotive force of a reactor.
[Claim 5] In the drive method of a capacitive load of impressing the pulse of positive/negative amphipathy to the capacitive load which has the 1st and 2nd electrodes by turns Maintaining the step and the 2nd electrode which collect charges from the 1st electrode and maintain the 1st electrode subsequently to the 1st potential, maintaining the 2nd electrode to one predetermined potential to aforementioned one predetermined potential Carrying out floating of the step and the 2nd electrode which return a charge to the 1st electrode and maintain the 1st electrode subsequently to the 2nd potential Maintaining the step and the 2nd electrode which collect charges from the 1st electrode to the predetermined potential of another side Maintaining the step and the 2nd electrode which return a charge to the 1st electrode and maintain the 1st electrode subsequently to the 2nd potential to the predetermined potential of aforementioned another side The drive method of the capacitive load characterized by having periodically [boil the step which returns a charge to the 1st electrode and maintains the 1st electrode subsequently to the 2nd potential one by one, carrying out floating of the step which collects charges from the 1st electrode, and the 2nd electrode, and].
[Claim 6] In the drive method of a capacitive load of impressing the pulse of positive/negative amphipathy to the capacitive load which has the 1st and 2nd electrodes by turns Maintaining the step and the 2nd electrode which give a charge to the 1st electrode and maintain the 1st electrode subsequently to the 1st potential, maintaining the 2nd electrode to one predetermined potential to the aforementioned predetermined potential Carrying out floating of the step and the 2nd electrode which collect charges from the 1st electrode and maintain the 1st electrode subsequently to the 2nd potential Maintaining the step and the 2nd electrode which give a charge to the 1st electrode to the predetermined potential of another side Maintaining the step and the 2nd electrode which collect charges from the 1st electrode and maintain the 1st electrode subsequently to the 2nd potential to the predetermined potential of aforementioned another side The drive method of the capacitive load characterized by having periodically [boil the step which collects charges from the 1st electrode and maintains the 1st electrode subsequently to the 2nd potential one by one, carrying out floating of the step which gives a charge to the 1st electrode, and the 2nd electrode, and].
[Claim 7] The drive method of the capacitive load according to claim 5 or 6 characterized by the aforementioned capacitive load being a flat display panel.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to charge recovery type the drive circuit and method of a capacitive load which can be especially manufactured by part mark fewer than before about the drive circuit and the drive method of a capacitive load.
[0002]
[Description of the Prior Art] As a capacitive load which needs the bipolar pulse of positive/negative, there are flat panels, such as the plasma display panel and electro luminescent panel which are used as image display equipments, such as an information terminal equipment, and a personal computer or television, and a liquid crystal panel, etc. As a drive circuit of the conventional capacitive load, the drive circuit of a plasma display panel (PDP) is described here.
[0003] Drawing 9 is a cross section which meets the train electrode of one display cell of PDP. PDP is equipped with the 1st insulating substrate 11 of a glass front face, and the 2nd insulating substrate 12 on the back in this drawing. On the 1st insulating substrate 11, the 1st insulating layer 20 of a wrap and the 1st septum 21 of the shape of a grid which divides a display cell are formed one by one in the transparent scanning electrode 17 and the transparent maintenance electrode 18 which constitute a line electrode, the bus electrode 19 formed on each [these] line electrode, and the whole electrode, and the protective layer 22 which covers the 1st insulating layer 20 and consists of MgO etc. further is formed.
[0004] On the 2nd insulating substrate 12, the 2nd septum 15 of the shape of the shape of a grid which divides a display cell in collaboration with the 2nd insulating layer 14 of a wrap and the 1st septum 15, and a stripe is formed one by one in the transparent train electrode (data electrode) 13 which intersects perpendicularly with a line electrode, and a train electrode, these whole is covered, and the fluorescent substance 16 is applied. The discharge-gas space 23 which constitutes each display cell by the 1st and 2nd septa 21 and 15 is formed in the shape of a grid, and the discharge-gas space 23 is filled up with discharge gases, such as rare gas.
[0005] Drawing 10 is a mimetic diagram shown in the electrode composition paying attention to the whole above PDP. PDP25 has the structure where the 1st front insulating substrate 11 and the 2nd insulating substrate 12 on the back were made to rival, and the seal of the building envelope is airtightly carried out by the seal section 26. On a drawing, each scanning electrode 17 is a sign S1, and S2, ..., Sm, each maintenance electrode 18 is a sign C1, and C2, ..., Cm, and each train electrode 13 is shown by a sign D1, D2, ..., Dn-1, and Dn. In addition, in the following description, aij shows the display cell 24 of the intersection of the i-th line electrode and the j-th train electrode, for example.
[0006] Drawing 11 shows the wave of the driver voltage used by the drive of Above PDP. Setting to this drawing, a wave (A) is the maintenance electrode C1, and C2, ..., Cm. The voltage waveform impressed A wave (B) is the scanning electrode S1. The voltage waveform by which the voltage waveform impressed is impressed to a wave (C) by the scanning electrode S2 For a wave (D), about the voltage waveform impressed to the scanning electrode Sm, a wave (E) is the train electrode D1. The wave (G) shows the luminescence wave of the display cell a11 for the voltage waveform by which the voltage waveform impressed is impressed to a wave (F) by the train electrode D2, respectively. In addition, the slash pulse of the data pulses 34 shown by the wave (E) and the wave (F) shows that the existence of a pulse is determined according to the data which should be written in.
[0007] Hereafter, operation of the conventional PDP of the above-mentioned form is explained briefly. In addition, the first transition of a pulse points out a pulse portion after, as for a pulse portion after impression of a pulse voltage starts until it reaches the abbreviation last voltage, and the trailing edge of a pulse, removal of a pulse voltage starts until a pulse voltage is removed nearly completely into this specification. For example, in a straight polarity pulse, a start portion is the first transition of a pulse, and a fall portion is the trailing edge. Moreover, in a negative polarity pulse, the fall portion of a pulse is first transition and the standup portion of a pulse is a trailing edge.
[0008] First, each scanning electrode S1, and S2, ..., Sm By impressing the elimination pulses 35 of negative polarity all at once, the maintenance electric discharge till then is once eliminated. the next -- the priming pulse 36 of negative polarity with a big amplitude -- all the maintenance electrodes C1 and C2 and ... it is impressed by Cm and priming electric discharge which generates the priming particle which serves as a kind of electric discharge in the case of write-in electric discharge is performed all over a panel Subsequently, they are each scanning electrode S1, and S2, ..., Sm about the priming elimination pulse 37 with a small amplitude so that priming electric discharge may not lead to maintenance electric discharge as it is. It impresses all at once.

[0009] Then, it synchronizes with this pulse and they are each train electrodes D1 and D2, ..., Dn-1, and Dn at the same time it goes into a write-in conducting period and impresses the scanning pulse 33 to each scanning electrode S1, and S2, ..., Sm line sequential. The data pulse 34 is impressed. By these scanning pulse 33 and the data pulse 34, it writes in a desired display cell and electric discharge is generated. In the example of drawing 11 , by the data voltage waveform (E) and (F), data are written in the display cells a11 and a22, and data are not written in the display cells a12 and a21, but the purport to which the writing according to data is carried out is shown about display cells other than these.
[0010] An end of a write-in conducting period impresses the maintenance pulses 31 and 32 of negative polarity to each scanning electrode and a maintenance electrode by turns, respectively. Between a scanning electrode and a maintenance electrode, the police box maintenance pulse from which polarity changes by turns is impressed by these maintenance pulses 31 and 32. By this police box maintenance pulse, maintenance electric discharge occurs between the scanning electrode 17 and the maintenance electrode 18 in the display cell 24 which wrote in before and had electric discharge, and the display according to data is performed. Display brightness is controlled by the number of times which impresses these maintenance pulses 31 and 32.
[0011]
[Problem(s) to be Solved by the Invention] By the drive circuit and method of PDP of the above-mentioned former, the charge and discharge of the electrostatic capacity formed mainly between the scanning electrode of the display cell section and a maintenance electrode whenever a maintenance pulse is impressed to a scanning electrode and a maintenance electrode, respectively are performed. For this reason, there was a fault that the so-called consumption of the power for the charge and discharge of this electrostatic capacity and reactive power was large, in addition to luminescence power required for a display originally.
[0012] In order to remove the above-mentioned fault, the charge recovery type drive circuit which has the charge recovery circuit which collects the electric discharge charges of the electrostatic capacity in the case of each maintenance pulse impression is proposed (for example, a patent public presentation [Heisei 5] No. 265397, 63 years [of patent public presentation Showa] No. 101897). Here, drawing 11 , drawing 12 , and drawing 13 are collectively referred to supposing the case where the drive wave shown in drawing 11 is used, and the conventional charge recovery type drive circuit is explained. Drawing 12 shows the drive circuit of the conventional PDP of this form as a block diagram, and drawing 13 shows each block of drawing 12 as a fundamental circuit diagram. At drawing 13 , the same reference mark showed the element corresponding to the element of drawing 12 .
[0013] In drawing 12 , the PDP drive circuit is prepared for the drive of PDP25 containing the display cell group 41 which has the scanning electrode 17 and the maintenance electrode 18. A PDP drive circuit includes the priming pulse generator 42 which impresses the priming pulse 36 to the maintenance electrode 18, and a charge recovery circuit. The maintenance electrode side maintenance pulse generator 43 which impresses the maintenance pulse 31 to the maintenance electrode 18, the elimination pulse generator 44 which generates the elimination pulse 35 and the priming elimination pulse 37, the scanning pulse generator 45 which generates the scanning pulse 33, and a charge recovery circuit are included. Corresponding to the function, it has a package or the mixed circuit 47 impressed individually in each scanning electrode 17 for the scanning electrode side maintenance pulse generator 46 which generates the maintenance pulse 32 by the side of a scanning electrode and the maintenance pulse 32 by the side of a scanning electrode, the scanning pulse 33, and elimination pulse 35 grade.
[0014] In drawing 13 , the maintenance electrode side maintenance pulse generator 43 consists of clamping circuit 43a and charge recovery circuit 43b, and the scanning electrode side maintenance pulse generator 46 consists of clamping circuit 46a and charge recovery circuit 46b similarly. Each clamping circuits 43a and 46a are constituted as a switching circuit which fixes a corresponding electrode to power supply potential-VS or grounding (gland) potential periodically (clamp), and each charge recovery circuits 43b and 46b consist of the coils 101, 102, and 103 and the charge recovery capacitors 111 and 112 which constitute LC resonance circuit. Each charge recovery circuits 43b and 46b have the function to collect from these the charges accumulated at the corresponding scanning electrode 17 or the corresponding maintenance electrode 18, and to return the charge to these, and hold down consumption of reactive power by this function.
[0015] As mentioned above, the charge recovery circuits 43b and 46b are again returned to the electrode which is prepared in each by the side of the maintenance electrode 18 and the scanning electrode 17, and generally once collects the charges accumulated at these electrodes, and corresponds this charge. By the way, it consists of a switching circuit and LC resonance circuit, and circuitry is complicated, the manufacture costs also increase, and these charges recovery circuit has the fault of raising the cost of the whole drive circuit greatly.
[0016] Especially, in a maintenance electrode side, a voltage swing treats the high priming pulse 36. For this reason, it is necessary to use a high withstand-voltage element also for charge recovery circuit 43b contained in the maintenance electrode side maintenance pulse generator 43. Such a high withstand-voltage element is expensive, and causes the further cost rise of a drive circuit.
[0017] The purpose of this invention is improving and having the drive circuit of the conventional capacitive load which has a charge recovery circuit, and adopting simple composition, and is to offer the drive circuit of the capacitive load which has a charge recovery circuit which can be manufactured by the low price.
[0018]
[Means for Solving the Problem] In the drive circuit of a capacitive load where the drive circuit of the capacitive load of this invention impresses the pulse of positive/negative amphipathy to the capacitive load which has the 1st and 2nd electrodes by turns in order to attain the above-mentioned purpose The charge recovery circuit which delivers and receives a charge

periodically between the 1st electrode of the above, The 1st clamping circuit which clamps the 1st electrode of the above to the 1st or 2nd predetermined potential in some [at least] periods other than the period of transfer of the aforementioned charge, While clamping the 2nd electrode of the above to the 3rd or 4th predetermined potential, it is characterized by having the 2nd clamping circuit to which floating of the 2nd electrode of the above is carried out corresponding to the period of transfer of some aforementioned charges.

[0019] Moreover, the drive method of the capacitive load of this invention is set to the drive method of a capacitive load of impressing the pulse of positive/negative amphipathy to the capacitive load which has the 1st and 2nd electrodes by turns. Maintaining the step and the 2nd electrode which collect charges from the 1st electrode and maintain the 1st electrode subsequently to the 1st potential, maintaining the 2nd electrode to one predetermined potential to the aforementioned predetermined potential Carrying out floating of the step and the 2nd electrode which return a charge to the 1st electrode and maintain the 1st electrode subsequently to the 2nd potential Maintaining the step and the 2nd electrode which collect charges from the 1st electrode to the predetermined potential of another side Maintaining the step and the 2nd electrode which return a charge to the 1st electrode and maintain the 1st electrode subsequently to the 2nd potential to the predetermined potential of aforementioned another side Carrying out floating of the step which collects charges from the 1st electrode, and the 2nd electrode, the step which returns a charge to the 1st electrode and maintains the 1st electrode subsequently to the 2nd potential is boiled one by one, and it is characterized by having periodically.

[0020] It replaces with above. the drive method of the plasma display panel of this invention In the drive method of a capacitive load of impressing the pulse of positive/negative amphipathy to the capacitive load which has the 1st and 2nd electrodes by turns Maintaining the step and the 2nd electrode which give a charge to the 1st electrode and maintain the 1st electrode subsequently to the 1st potential, maintaining the 2nd electrode to one predetermined potential to the aforementioned predetermined potential Carrying out floating of the step and the 2nd electrode which collect charges from the 1st electrode and maintain the 1st electrode subsequently to the 2nd potential Maintaining the step and the 2nd electrode which give a charge to the 1st electrode to the predetermined potential of another side Maintaining the step and the 2nd electrode which collect charges from the 1st electrode and maintain the 1st electrode subsequently to the 2nd potential to the predetermined potential of aforementioned another side Carrying out floating of the step which gives a charge to the 1st electrode, and the 2nd electrode, the step which collects charges from the 1st electrode and maintains the 1st electrode subsequently to the 2nd potential can be boiled one by one, and it can also constitute so that it may be characterized by having periodically.

[0021] There is especially no limit in the capacitive load driven by the drive circuit and the drive method of a capacitive load of this invention here, and each pulse of positive/negative polarity should just be the capacitive load driven by the police box pulse which appears by turns. For example, flat-surface panels, such as a plasma display panel, an electroluminescence panel (EL panel), and a liquid crystal panel, are mentioned.

[0022]

[Function] By the drive circuit and the drive method of a capacitive load of this invention In case the charges of the 1st electrode are collected and the potential of the 1st electrode is reduced, floating of the 2nd electrode is carried out. The 2nd electrode is made to follow potential change of the 1st electrode using the 1st electrode and the 2nd inter-electrode capacity coupling. In case similarly a charge is returned to the 1st electrode and the potential of the 1st electrode is started, floating of the 2nd electrode can be carried out, and the 2nd electrode can be made to follow potential change of the 1st electrode. Here, a desired potential change can be given to the 2nd electrode without establishing a charge recovery circuit in a 2nd electrode side by combining fixation of the potential of the 2nd electrode, and flattery of the potential change by floating by request.

[0023]

[Example] Hereafter, with reference to a drawing, this invention is explained still in detail based on the suitable example of this invention. Here, as a capacitive load driven in the drive circuit of the capacitive load of this invention, a plasma display panel (PDP) is explained as an example like the conventional example. Drawing 1 is the block diagram of the drive circuit of the capacitive load of one example of this invention. Moreover, drawing 2 shows each block of drawing 1 as a basic circuit diagram. In the drive circuit of the capacitive load of this example, the maintenance electrode side maintenance pulse generator consists of only clamping circuits excluding the charge recovery circuit. Other block composition is the same as the block composition of the conventional drive circuit.

[0024] The maintenance electrode-clamp circuit 1 where the drive circuit of this example generates the maintenance pulse for the maintenance electrode 18 in drawing 1 , The priming pulse generator 42 which generates the priming pulse for the maintenance electrode 18, The scanning pulse generator 45 which generates a scanning pulse, and the scanning electrode maintenance pulse generator 46 which generates the maintenance pulse for a scanning electrode, Each scanning electrode 17 constitutes the elimination pulse generator 44 which generates the elimination pulse and priming elimination pulse for a scanning electrode, a scanning pulse and a maintenance pulse, an elimination pulse, etc. from a package or a mixed circuit 47 given individually.

[0025] In drawing 2 , the output of the maintenance electrode-clamp circuit 1 has the switches 159 and 158 for connecting with the maintenance electrode 18 connected in common, and fixing a maintenance electrode to -VS potential or a ground potential periodically, or making it floating. Peak value the priming pulse generator 42 to the maintenance electrode 18 - The priming pulse of VP is given.

[0026] The mixed circuit 47 is equipped with one pair of diodes, 121 and 123, which are arranged every scanning electrode 17 and connected mutually in series, and 122 and 124, and the connection node which connects one pair each of diodes

mutually is connected to each scanning electrode 17, respectively. [for example,] By this composition, it functions as the mixed circuit 47 giving a scanning pulse, an elimination pulse, a priming elimination pulse, and the maintenance pulse by the side of a scanning electrode individually to each scanning electrode 17 for every kind of the at a package.
[0027] The scanning pulse generator 45 has one pair of switches, 151 and 153, arranged every scanning electrode 17, and 152 and 154, and the connection node of one pair each of switches is connected to each scanning electrode 17 which corresponds via the mixed circuit 47, respectively. [for example,] Peak value the elimination pulse generator 44 - The priming elimination pulse or peak value of VPE generates the elimination pulse of -VE, and gives these at a package to the scanning electrode 17 via the mixed circuit 47. The scanning electrode maintenance pulse generator 46 has the function to collect the charges of the scanning electrode 17 at the time of the maintenance pulse supply while it consists of scanning electrode-clamp circuit 46a and charge recovery circuit 46b and supplies a maintenance pulse to the scanning electrode 17 via the mixed circuit 47.
[0028] Drawing 3 is the timing chart showing operation of one period in drawing 1 and the maintenance pulse impression period in PDP of drawing 2 . In this drawing, a wave 51 shows the maintenance pulse train by which the maintenance pulse train impressed to the scanning electrode 17 is impressed to a wave 52 by the maintenance electrode 18, respectively. Moreover, a wave 53 is the voltage difference of the scanning electrode 17 and the maintenance electrode 18, and shows the police box maintenance pulse train which is impressed to the discharge space of each display cell, and functions effectively because of charge maintenance. ON of each switch and the timing of OFF are further shown in drawing 3 , and reference marks 60-72 show each operation period in one period in a maintenance conducting period to it.
[0029] As for the inside of a maintenance conducting period, since, as for each switches 151-157 in the scanning pulse generator 45, the priming pulse generator 42, and the elimination pulse generator 44, there is no direct relation to generating and impression of this maintenance pulse, they are maintained at the state of OFF by each.
[0030] First, in the period 60, the switch 158 of the maintenance electrode-clamp circuit 1 is set to ON, therefore, as for the scanning electrode 17 and the maintenance electrode 18, the switch 160 of ON and scanning electrode-clamp circuit 46a is all clamped for it by the ground potential. Moreover, the potential of the charge recovery capacitor 111 in charge recovery circuit 46b is in abbreviation-VS potential at this time.
[0031] In a period 61, the switch 163 of OFF and charge recovery circuit 46b is set to ON for the switch 160 of scanning electrode-clamp circuit 46a with ** which set the switch 158 of the maintenance electrode-clamp circuit 1 to ON. Thereby, via one diode of the coil 102 in charge recovery circuit 46b, diode 126, and one pair each of diodes of the mixed circuit 47, 123 and 124, the charges of the scanning electrode 17 are collected to the charge recovery capacitor 111, and the potential of a scanning electrode is reduced even in -VS neighborhood by LC resonance. [for example,] At this time, the terminal voltage of the charge recovery capacitor 111 starts to a ground potential to near.
[0032] In a period 62, the switch 161 in OFF and scanning electrode-clamp circuit 46a is again set to ON for the switch 163 in charge recovery circuit 46b, and the potential of the scanning electrode 17 is clamped to the potential of -VS. In a period 63, the switch 162 in OFF and charge recovery circuit 46b is set to ON for a switch 161, the charge of the charge recovery capacitor 111 is returned to the scanning electrode 17 side via the diode, 121 and 122, of another side of the coil 101 in charge recovery circuit 46b, diode 125, and a pair each of diode in the mixed circuit 47, and the potential of the scanning electrode 17 is again started to the ground-potential neighborhood. [for example,] At this time, the potential of the charge recovery capacitor 111 falls even to -VS neighborhood mostly.
[0033] In a period 64, the switch 160 of OFF and scanning electrode-clamp circuit 46a is set to ON for a switch 162, and the potential of the scanning electrode 17 is clamped to a ground potential. Operation from the above-mentioned period 60 to a period 64 is the same as that of operation in the charge recovery type drive circuit of the conventional capacitive load. Here, the maintenance pulse 54 of the negative polarity which has first transition and a trailing edge in periods 61 and 63, respectively is impressed to the scanning electrode 17 before periods 61-63.
[0034] Then, in a period 65, the switch 158 in ON and the maintenance electrode-clamp circuit 1 is made [the switch 160 in scanning electrode-clamp circuit 46a] off for the switch 163 of OFF and charge recovery circuit 46b. By ON of a switch 163, the charges of the scanning electrode 17 are collected by the charge recovery capacitor 111, and the potential of the scanning electrode 17 falls even to -VS neighborhood mostly. Since the switches 157, 158, and 159 which have led to the maintenance electrode 18 at this time are OFF altogether, a maintenance electrode is in floating and the potential of the maintenance electrode 18 is followed by capacity coupling of the maintenance electrode 18 and the scanning electrode 17 at the potential of the scanning electrode 17.
[0035] In a period 66, the switch 159 of OFF and the maintenance electrode-clamp circuit 1 is set to ON for a switch 163, and the potential of the maintenance electrode 18 is clamped to -VS. Subsequently, in a period 67, the potential of the scanning electrode 17 is mostly started even in the ground-potential neighborhood by setting the switch 162 of charge recovery circuit 46b to ON, and returning a charge from the charge recovery capacitor 111. As shown in a wave 51 from a period 65 to the above period 67, the maintenance pulse 57 of the negative polarity which has first transition and a trailing edge in periods 65 and 67 is impressed to the scanning electrode 17. subsequently, a switch 162 is turned OFF in a period 68 -- the scanning electrode 17 is both clamped to a ground potential by setting the switch 160 of scanning electrode-clamp circuit 46a to ON
[0036] In a period 69, the switch 163 of OFF and charge recovery circuit 46b is set to ON for the switch 160 of scanning electrode-clamp circuit 46a, charges are collected to the charge recovery capacitor 111, and the potential of the scanning electrode 17 is again reduced even in -VS neighborhood. Since the switch 159 of the maintenance electrode-clamp circuit 1 is set to ON like the above at this time, the potential of the maintenance electrode 18 is fixed to -VS.

[0037] Subsequently, a switch 163 is made off in a period 70. In a period 71, the switch 159 of the maintenance electrode-clamp circuit 1 is further made off in this state. Simultaneously, the switch 162 of charge recovery circuit 46b is set to ON, a charge is returned to the scanning electrode 17 side from the charge recovery capacitor 111, and the voltage of the scanning electrode 17 is mostly started even to a ground potential. since all the switches that lead to the maintenance electrode 18 are OFF states at this time -- the maintenance electrode 18 -- floating -- it is -- capacity coupling of the maintenance electrode 18 and the scanning electrode 17 -- the potential of the maintenance electrode 18 -- the potential of the scanning electrode 17 -- following -- this -- ** -- it starts in parallel As shown in a wave 51 from a period 69 to the above period 71, the maintenance pulse 58 of the negative polarity which has first transition and a trailing edge in periods 69 and 71, respectively is impressed to the scanning electrode 17.
[0038] Subsequently, in a period 72, the scanning electrode 17 and the maintenance electrode 18 are clamped to a ground potential, respectively by setting the switch 160 of scanning electrode-clamp circuit 46a, and the switch 158 of a maintenance electrode-clamp circuit to ON. As shown in the maintenance electrode 18 in a wave 52 from the above period 65 before a period 72, the maintenance pulse 56 of the negative polarity which has first transition and a trailing edge, respectively is impressed to periods 65 and 72.
[0039] It will set by the above-mentioned periods 60-72. between the scanning electrode 17 and the maintenance electrode 18 The pulse 55 of the negative polarity obtained by the maintenance pulse 54 of negative polarity and the ground potential of the maintenance electrode 18 which are impressed to the scanning electrode 17 so that a wave 53 may see, The pulse 59 of the straight polarity by the ground potential between the maintenance pulses 57 and 58 of the scanning electrode 17 and the negative-potential level in the maintenance pulse 56 impression period of the negative polarity of the maintenance electrode 18 is impressed. That is, the police box maintenance pulse which contributes to maintenance electric discharge is impressed to the discharge space between the scanning electrode 17 in the display cell group 41, and the maintenance electrode 18.
[0040] By repeating periodically drive operation which makes one period from the above period 60 to the period 72, a police box maintenance pulse can be repeated and impressed to the display cell group 41. Therefore, a capacitive load can be driven by charge recovery type drive, without establishing a charge recovery circuit in a maintenance electrode side by using the drive circuit of the above-mentioned example. Thereby, the cost cut by the simplification of a circuit and improvement in the reliability accompanying reduction of the number of elements are realizable.
[0041] In addition, in the composition of the above-mentioned example, the composition which replaces with return of the charge to the charge recovery from a scanning electrode and a scanning electrode, and performs grant of the charge to a scanning electrode and recovery from these, respectively is also employable. In this case, in the period 60 of the beginning of one period, a scanning electrode and a maintenance electrode are maintained to -VS, respectively, and let potential of a charge recovery capacitor be abbreviation grand level. Hereafter, it replaces with recovery of the aforementioned charge, grant of a charge is replaced with return of a charge, and charges are collected. Also in this case, the same effect as the above-mentioned example is acquired.
[0042] Moreover, in description of the above-mentioned example, although explained with reference to the basic circuit of drawing 2 , the above-mentioned circuit is easily realizable using the present electronics technology. The case where the above-mentioned switch is realized by the field-effect transistor (it outlines Following FET) is illustrated to drawing 4 . In this drawing, reference mark 151F to 158F and 160F to 163F show FET corresponding to 158 and 160 to 163 from the switch 151 of drawing 2 , respectively.
[0043] Although the circuit of drawing 4 has the substantial almost same circuitry as the circuit of drawing 2 , in drawing 4 , FET group 159F which function as a bidirectional switch which consists of P channel FET (159FP) and N channel FET (159FN) are prepared corresponding to the switch 159 of drawing 2 . This prevents that the maintenance electrode 18 sways greatly in the minus direction further from peak value-VS in a period 69.
[0044] Generally, it is known for FET that parasitism diode will be formed in the portion which functions as a switch in parallel. For example, as shown in drawing 5 , the parasitism diode 92 enters in P channel FET91, and the parasitism diode 94 enters in parallel in N channel FET93. In order to prevent the short-circuit current resulting from these parasitism diodes 92 and 94, diodes 129-134 are formed in drawing 4 .
[0045] Peak value of the priming pulse 36 impressed to a maintenance electrode as shown in drawing 11 as an example - VP considers the larger case in the negative direction of being general than peak value-VS of the maintenance pulse 31. When diode 132 was not formed in the maintenance electrode-clamp circuit 1 and FET (157F) of the priming pulse generator 42 is set to ON in order to generate the priming pulse 36, it is -VS power supply line. A short-circuit current will flow to a ->FET(159FN) -> diode 131 ->FET(157F) ->-VP power supply line. Other diodes which are not shown are formed in drawing 2 for the same purpose.
[0046] In addition, the above-mentioned example described as an example the case where the maintenance pulse of negative polarity was impressed to the scanning electrode 17 and the maintenance electrode 18. However, the drive circuit of this invention can be applied, the scanning electrode 17, when reaching and impressing the maintenance pulse of straight polarity to the maintenance electrode 18, respectively, and not only this but when. Drawing 6 is the basic circuit diagram of the drive circuit of the 2nd example showing this case. Corresponding to the coils 101 and 102 in drawing 2 , the charge recovery capacitor 111, diodes 121-126, and each of switches 151-153, coils 201 and 202, the charge recovery capacitor 211, diodes 221-226, and switches 251-263 are arranged. About foundations of operation, since it is the same as that of the case of drawing 2 , detailed explanation is omitted.
[0047] In addition, as for the electrostatic capacity of the charge recovery capacitors 111 and 211, in each above-mentioned

example, it is desirable to set up more than the sum total of the electrostatic capacity of the display cell section 41 of PDP which constitutes a load. Moreover, the reactance of a coil takes into consideration the working speed of PDP, and LC resonance frequency of a circuit, and is determined.

[0048] Drawing 7 is drawing showing the composition of the 3rd example of this invention with drawing 2 similarly. Unlike the composition of charge recovery circuit 46b of drawing 2 , in this example, the composition of other composition of charge recovery circuit 46c is the same as that of drawing 2 . In addition, the example of analogous is seen by the patent public notice common No. 81912 [five to] official report in the charge recovery circuit shown in drawing 7 . Drawing 8 is the timing chart showing similarly operation and the driver voltage wave of each switch in drawing 7 with drawing 3 .

[0049] Although not shown in drawing 8 , since, as for during the period which is impressing the maintenance pulse, there was no direct relation to generating and impression of a maintenance pulse, it has kept switches 151-157 each to the OFF state like the 1st example.

[0050] In a period 60, the switch 160 of ON and scanning electrode-clamp circuit 46a is also ON, and the scanning electrode 17 and the maintenance electrode 18 are all clamped for the switch 158 of the maintenance electrode-clamp circuit 1 by the ground potential.

[0051] In a period 61, the switch 160 of scanning electrode-clamp circuit 46a is made off, setting the switch 158 of the maintenance electrode-clamp circuit 1 to ON. Moreover, once set the switch 167 of charge recovery circuit 46c to ON, -VS power supply line is made to flow through the scanning electrode 17 via each diodes 123 and 124 of the coil 105 of charge recovery circuit 46c, and the mixed circuit 47, and the potential of the scanning electrode 17 is reduced. a switch 167 is turned OFF when the potential of the scanning electrode 17 becomes or less -VS/2 (between -VS/2 - -VS and the following -- the same) At this time, each diode 123 of the scanning electrode 17 -> mixture circuit 47 and a 124 -> coil 105 -> diode 138 -> gland, and the current from the scanning electrode 17 flow continuously by operation of the counter-electromotive force generated in a coil 105. Thus, current is passed until the scanning electrode 17 serves as potential of -VS, reducing the power loss of a circuit. Diode 137 has the function to return the power with which the coil 105 remained to -VS power supply line, in cooperation with diode 138 while the voltage by the side of the cathode of diode 137 prevents a bird clapper below to -VS.

[0052] In a period 62, the switch 161 in scanning electrode-clamp circuit 46a is set to ON, and the voltage of the scanning electrode 17 is clamped to -VS. Subsequently, in a period 63, once set the switch 166 of OFF and charge recovery circuit 46c to ON for a switch 161, a gland is made to flow through the scanning electrode 17, and the potential of a scanning electrode is started. A switch 166 is turned OFF when the potential of the scanning electrode 17 becomes or more -VS/2. By operation of the counter-electromotive force generated in a coil 104, the current of each diode 121 of the -VS power supply -> diode 136 -> coil 104 -> mixture circuit 47 and the 122 -> scanning electrode 17, and a scanning electrode flows continuously. Thus, the scanning electrode 17 is started to a ground potential, reducing the power loss of a circuit. Diode 135 has the function to return the power with which the coil 104 remained to -VS power supply, in cooperation with diode 136 while the potential by the side of the anode of diode 135 prevents a bird clapper more than a ground potential.

[0053] In a period 64, the potential of the scanning electrode 17 is clamped to a ground potential by setting the switch 160 in scanning electrode-clamp circuit 46a to ON. The maintenance pulse 84 is impressed to the scanning electrode 17 between a period 61 and a period 63. The foundations of operation from a period 60 to a period 64 are the same as that of circuit operation shown in a patent public notice common 5-81912. Next, based on this invention, the portion which impresses a maintenance pulse to the maintenance electrode 18 by charge recovery circuit 46c is explained.

[0054] First, in a period 65, the switch 158 of OFF and the maintenance electrode-clamp circuit 1 is made off for a switch 160, and the potential of the scanning electrode 17 is once reduced in the negative direction by setting the switch 167 of charge recovery circuit 46c to ON. The operation of charge recovery circuit 46c at this time itself is the same as operation in a period 61, and it will make a switch 167 off by the time of the end of a period 65. However, in a period 65, since the switches 157, 158, and 159 which lead to the maintenance electrode 18 are altogether made into the OFF state, a maintenance electrode is in floating, and as shown in a wave 82, the potential of the maintenance electrode 18 also follows the potential of the scanning electrode 17, and is reduced.

[0055] In a period 66, the potential of the maintenance electrode 18 is clamped to -VS by setting the switch 159 of the maintenance electrode-clamp circuit 1 to ON. Subsequently, in a period 67, the switch 166 of charge recovery circuit 46c is once set to ON, the voltage of the scanning electrode 17 is started in the grand level direction, and a switch 166 is made off before the end of a period 67. The scanning electrode 17 starts to a ground potential within a period 67 by operation of the counter-electromotive force of a coil. As shown in a wave 81 from a period 65 to the above period 67, the maintenance pulse 87 is impressed to the scanning electrode 17. Then, in a period 68, the potential of the scanning electrode 17 is clamped to a ground potential by setting the switch 160 of scanning electrode-clamp circuit 46a to ON.

[0056] In a period 69, the switch 167 of OFF and charge recovery circuit 46c is once set to ON for the switch 160 of scanning electrode-clamp circuit 46a, and the potential of the scanning electrode 17 is again reduced in the negative direction. Since the switch 159 of the maintenance electrode-clamp circuit 1 is set to ON at this time, the potential of a maintenance electrode is clamped by -VS. When the potential of the scanning electrode 17 amounts to or less -VS/2, a switch 167 is turned OFF like the case of a period 61.

[0057] In a period 70, the switch 159 of the maintenance electrode-clamp circuit 1 is still ON. A switch 159 is made off in the next period 71, and all the switches that lead to the maintenance electrode 18 are made into an OFF state. With this, the potential of the scanning electrode 17 is once started in the grand level direction by setting the switch 166 of charge recovery circuit 46c to ON. Since the maintenance electrode 18 is in floating at this time, the potential of the maintenance electrode 18

also follows the potential of the scanning electrode 17, and is started. When the potential of the scanning electrode 17 amounts to or more -VS/2, a switch 166 is made off like a period 63. As shown in a wave 81 from a period 69 to the above period 71, the maintenance pulse 88 is impressed to the scanning electrode 17.

[0058] In a period 72, the scanning electrode 17 and the maintenance electrode 18 are clamped to a ground potential, respectively by setting the switch 160 of scanning electrode-clamp circuit 46a, and the switch 158 of the maintenance electrode-clamp circuit 1 to ON. The maintenance pulse 86 is impressed to the maintenance electrode 18 by operation from the above period 65 to a period 72.

[0059] By the above-mentioned operation, the voltage pulse impressed between a scanning electrode and a maintenance electrode turns into the pulse 85 of the negative polarity by periods 61-63, and the pulse 89 of the straight polarity by periods 67-69, and the police box pulse 83 is impressed between a scanning electrode and a maintenance electrode like the 1st example.

[0060] In a maintenance conducting period, the police box maintenance pulse 83 can be repeated and impressed to the display cell group 41 by repeating periodically operation which makes one period from the period 60 to the period 72. Therefore, also in the 3rd example, the charge recovery type drive of a capacitive load is attained, without establishing a charge recovery circuit in a maintenance electrode side.

[0061] Each above-mentioned example described the drive circuit and the drive method of a capacitive load of this invention by making into an example the case where PDP of form explained with reference to drawing 9 and drawing 10 is driven. However, this invention is applicable not only to the drive of PDP of this form but the drive of AC type PDP of other form. Moreover, it is employable suitable not only for PDP but flat-surface panels, such as other capacitive display panels, for example, an electro luminescent panel, and a liquid crystal panel. Furthermore, generally, this invention is applicable to the drive of any capacitive loads, if impression of the pulse of positive/negative amphipathy is a required capacitive load.

[0062] In the composition of each above-mentioned example, although explained based on the suitable mode of this invention, correction and change various from the composition of the above-mentioned example are possible. For example, although the practical use circuit of drawing 4 showed the example which adopted FET as a switch, it can replace with FET and a bipolar transistor etc. can be adopted. Moreover, it can also constitute so that it may replace with a scanning electrode side and a charge recovery circuit may be established in a maintenance electrode side. In addition, in this case, by PDP, the operating voltage by the side of a maintenance electrode may originate in a high thing, and the cost of passive circuit elements may go up as compared with the case of an example. Furthermore, although each above-mentioned example described the case where a charge recovery circuit was used for all the periods of the first transition of a maintenance pulse, and a trailing edge, it replaces with this and you may make it use the charge recovery circuit in this invention for a part of first transition of a maintenance pulse, and/or trailing edge.

[0063]

[Effect of the Invention] Since the generating circuit of the police box pulse impressed to a capacitive load is realizable by simple circuitry according to the drive circuit and the drive method of a capacitive load of this invention as explained above, this invention does so the remarkable effect which held down low the cost of the charge recovery type drive circuit of a capacitive load, and raised circuit reliability.

[Translation done.]

* NOTICES *

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3.In the drawings, any words are not translated.

TECHNICAL FIELD

[Industrial Application] this invention relates to charge recovery type the drive circuit and method of a capacitive load which can be especially manufactured by part mark fewer than before about the drive circuit and the drive method of a capacitive load.

[Translation done.]

PRIOR ART

[Description of the Prior Art] As a capacitive load which needs the bipolar pulse of positive/negative, there are flat panels, such as the plasma display panel and electro luminescent panel which are used as image display equipments, such as an information terminal equipment, and a personal computer or television, and a liquid crystal panel, etc. As a drive circuit of the conventional capacitive load, the drive circuit of a plasma display panel (PDP) is described here.

[0003] Drawing 9 is a cross section which meets the train electrode of one display cell of PDP. PDP is equipped with the 1st insulating substrate 11 of a glass front face, and the 2nd insulating substrate 12 on the back in this drawing. On the 1st insulating substrate 11, the 1st insulating layer 20 of a wrap and the 1st septum 21 of the shape of a grid which divides a display cell are formed one by one in the transparent scanning electrode 17 and the transparent maintenance electrode 18 which constitute a line electrode, the bus electrode 19 formed on each [these] line electrode, and the whole electrode, and the protective layer 22 which covers the 1st insulating layer 20 and consists of MgO etc. further is formed.

[0004] On the 2nd insulating substrate 12, the 2nd septum 15 of the shape of the shape of a grid which divides a display cell in collaboration with the 2nd insulating layer 14 of a wrap and the 1st septum 15, and a stripe is formed one by one in the transparent train electrode (data electrode) 13 which intersects perpendicularly with a line electrode, and a train electrode, these whole is covered, and the fluorescent substance 16 is applied. The discharge-gas space 23 which constitutes each display cell by the 1st and 2nd septa 21 and 15 is formed in the shape of a grid, and the discharge-gas space 23 is filled up with discharge gases, such as rare gas.

[0005] Drawing 10 is a mimetic diagram shown in the electrode composition paying attention to the whole above PDP. PDP25 has the structure where the 1st front insulating substrate 11 and the 2nd insulating substrate 12 on the back were made to rival, and the seal of the building envelope is airtightly carried out by the seal section 26. On a drawing, each scanning electrode 17 is a sign S1, and S2, ..., Sm, each maintenance electrode 18 is a sign C1, and C2, ..., Cm, and each train electrode 13 is shown by a sign D1, D2, ..., Dn-1, and Dn. In addition, in the following description, aij shows the display cell 24 of the intersection of the i-th line electrode and the j-th train electrode, for example.

[0006] Drawing 11 shows the wave of the driver voltage used by the drive of Above PDP. Setting to this drawing, a wave (A) is the maintenance electrode C1, and C2, ..., Cm. The voltage waveform impressed A wave (B) is the scanning electrode S1. The voltage waveform by which the voltage waveform impressed is impressed to a wave (C) by the scanning electrode S2 For a wave (D), about the voltage waveform impressed to the scanning electrode Sm, a wave (E) is the train electrode D1. The wave (G) shows the luminescence wave of the display cell a11 for the voltage waveform by which the voltage waveform impressed is impressed to a wave (F) by the train electrode D2, respectively. In addition, the slash pulse of the data pulses 34 shown by the wave (E) and the wave (F) shows that the existence of a pulse is determined according to the data which should be written in.

[0007] Hereafter, operation of the conventional PDP of the above-mentioned form is explained briefly. In addition, the first transition of a pulse points out a pulse portion after, as for a pulse portion after impression of a pulse voltage starts until it reaches the abbreviation last voltage, and the trailing edge of a pulse, removal of a pulse voltage starts until a pulse voltage is removed nearly completely into this specification. For example, in a straight polarity pulse, a start portion is the first transition of a pulse, and a fall portion is the trailing edge. Moreover, in a negative polarity pulse, the fall portion of a pulse is first transition and the standup portion of a pulse is a trailing edge.

[0008] First, each scanning electrode S1, and S2, ..., Sm By impressing the elimination pulses 35 of negative polarity all at once, the maintenance electric discharge till then is once eliminated. the next -- the priming pulse 36 of negative polarity with a big amplitude -- all the maintenance electrodes C1 and C2 and ... it is impressed by Cm and priming electric discharge which generates the priming particle which serves as a kind of electric discharge in the case of write-in electric discharge is performed all over a panel Subsequently, they are each scanning electrode S1, and S2, ..., Sm about the priming elimination pulse 37 with a small amplitude so that priming electric discharge may not lead to maintenance electric discharge as it is. It impresses all at once.

[0009] Then, it synchronizes with this pulse and they are each train electrodes D1 and D2, ..., Dn-1, and Dn at the same time it goes into a write-in conducting period and impresses the scanning pulse 33 to each scanning electrode S1, and S2, ..., Sm line sequential. The data pulse 34 is impressed. By these scanning pulse 33 and the data pulse 34, it writes in a desired display cell and electric discharge is generated. In the example of drawing 11 , by the data voltage waveform (E) and (F), data are written in the display cells a11 and a22, and data are not written in the display cells a12 and a21, but the purport to which the writing according to data is carried out is shown about display cells other than these.

[0010] An end of a write-in conducting period impresses the maintenance pulses 31 and 32 of negative polarity to each scanning electrode and a maintenance electrode by turns, respectively. Between a scanning electrode and a maintenance electrode, the police box maintenance pulse from which polarity changes by turns is impressed by these maintenance pulses 31 and 32. By this police box maintenance pulse, maintenance electric discharge occurs between the scanning electrode 17 and the maintenance electrode 18 in the display cell 24 which wrote in before and had electric discharge, and the display according to data is performed. Display brightness is controlled by the number of times which impresses these maintenance pulses 31 and 32.

[Translation done.]

* NOTICES *

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EFFECT OF THE INVENTION

[Effect of the Invention] Since the generating circuit of the police box pulse impressed to a capacitive load is realizable by simple circuitry according to the drive circuit and the drive method of a capacitive load of this invention as explained above, this invention does so the remarkable effect which held down low the cost of the charge recovery type drive circuit of a capacitive load, and raised circuit reliability.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the drive circuit and method of PDP of the above-mentioned former, the charge and discharge of the electrostatic capacity formed mainly between the scanning electrode of the display cell section and a maintenance electrode whenever a maintenance pulse is impressed to a scanning electrode and a maintenance electrode, respectively are performed. For this reason, there was a fault that the so-called consumption of the power for the charge and discharge of this electrostatic capacity and reactive power was large, in addition to luminescence power required for a display originally.

[0012] In order to remove the above-mentioned fault, the charge recovery type drive circuit which has the charge recovery circuit which collects the electric discharge charges of the electrostatic capacity in the case of each maintenance pulse impression is proposed (for example, a patent public presentation [Heisei 5] No. 265397, 63 years [of patent public presentation Showa] No. 101897). Here, drawing 11 , drawing 12 , and drawing 13 are collectively referred to supposing the case where the drive wave shown in drawing 11 is used, and the conventional charge recovery type drive circuit is explained. Drawing 12 shows the drive circuit of the conventional PDP of this form as a block diagram, and drawing 13 shows each block of drawing 12 as a fundamental circuit diagram. At drawing 13 , the same reference mark showed the element corresponding to the element of drawing 12 .

[0013] In drawing 12 , the PDP drive circuit is prepared for the drive of PDP25 containing the display cell group 41 which has the scanning electrode 17 and the maintenance electrode 18. A PDP drive circuit includes the priming pulse generator 42 which impresses the priming pulse 36 to the maintenance electrode 18, and a charge recovery circuit. The maintenance electrode side maintenance pulse generator 43 which impresses the maintenance pulse 31 to the maintenance electrode 18, the elimination pulse generator 44 which generates the elimination pulse 35 and the priming elimination pulse 37, the scanning pulse generator 45 which generates the scanning pulse 33, and a charge recovery circuit are included. Corresponding to the function, it has a package or the mixed circuit 47 impressed individually in each scanning electrode 17 for the scanning electrode side maintenance pulse generator 46 which generates the maintenance pulse 32 by the side of a scanning electrode and the maintenance pulse 32 by the side of a scanning electrode, the scanning pulse 33, and elimination pulse 35 grade.

[0014] In drawing 13 , the maintenance electrode side maintenance pulse generator 43 consists of clamping circuit 43a and charge recovery circuit 43b, and the scanning electrode side maintenance pulse generator 46 consists of clamping circuit 46a and charge recovery circuit 46b similarly. Each clamping circuits 43a and 46a are constituted as a switching circuit which fixes a corresponding electrode to power supply potential-VS or grounding (gland) potential periodically (clamp), and each charge recovery circuits 43b and 46b consist of the coils 101, 102, and 103 and the charge recovery capacitors 111 and 112 which constitute LC resonance circuit. Each charge recovery circuits 43b and 46b have the function to collect from these the charges accumulated at the corresponding scanning electrode 17 or the corresponding maintenance electrode 18, and to return the charge to these, and hold down consumption of reactive power by this function.

[0015] As mentioned above, the charge recovery circuits 43b and 46b are again returned to the electrode which is prepared in each by the side of the maintenance electrode 18 and the scanning electrode 17, and generally once collects the charges accumulated at these electrodes, and corresponds this charge. By the way, it consists of a switching circuit and LC resonance circuit, and circuitry is complicated, the manufacture costs also increase, and these charges recovery circuit has the fault of raising the cost of the whole drive circuit greatly.

[0016] Especially, in a maintenance electrode side, a voltage swing treats the high priming pulse 36. For this reason, it is necessary to use a high withstand-voltage element also for charge recovery circuit 43b contained in the maintenance electrode side maintenance pulse generator 43. Such a high withstand-voltage element is expensive, and causes the further cost elevation of a drive circuit.

[0017] The purpose of this invention is improving and having the drive circuit of the conventional capacitive load which has a charge recovery circuit, and adopting simple composition, and is to offer the drive circuit of the capacitive load which has a charge recovery circuit which can be manufactured by the low price.

[Translation done.]

MEANS

[Means for Solving the Problem] In order that this invention may attain the above-mentioned purpose, it is characterized by the drive circuit of a capacitive load which impresses the pulse of positive/negative amphipathy to the capacitive load which has the 1st and 2nd electrodes by turns possessing the following, as for the drive circuit of the capacitive load of this invention. The charge recovery circuit which delivers and receives a charge periodically between the 1st electrode of the above. The 1st clamping circuit which clamps the 1st electrode of the above to the 1st or 2nd predetermined potential in some [at least] periods other than the period of transfer of the aforementioned charge. The 2nd clamping circuit to which floating of the 2nd electrode of the above is carried out corresponding to the period of transfer of some aforementioned charges while clamping the 2nd electrode of the above to the 3rd or 4th predetermined potential.

[0019] Moreover, the drive method of the capacitive load of this invention is set to the drive method of a capacitive load of impressing the pulse of positive/negative amphipathy to the capacitive load which has the 1st and 2nd electrodes by turns. Maintaining the step and the 2nd electrode which collect charges from the 1st electrode and maintain the 1st electrode subsequently to the 1st potential, maintaining the 2nd electrode to one predetermined potential to the aforementioned predetermined potential Carrying out floating of the step and the 2nd electrode which return a charge to the 1st electrode and maintain the 1st electrode subsequently to the 2nd potential Maintaining the step and the 2nd electrode which collect charges from the 1st electrode to the predetermined potential of another side Maintaining the step and the 2nd electrode which return a charge to the 1st electrode and maintain the 1st electrode subsequently to the 2nd potential to the predetermined potential of aforementioned another side Carrying out floating of the step which collects charges from the 1st electrode, and the 2nd electrode, the step which returns a charge to the 1st electrode and maintains the 1st electrode subsequently to the 2nd potential is boiled one by one, and it is characterized by having periodically.

[0020] It replaces with above. the drive method of the plasma display panel of this invention In the drive method of a capacitive load of impressing the pulse of positive/negative amphipathy to the capacitive load which has the 1st and 2nd electrodes by turns Maintaining the step and the 2nd electrode which give a charge to the 1st electrode and maintain the 1st electrode subsequently to the 1st potential, maintaining the 2nd electrode to one predetermined potential to the aforementioned predetermined potential Carrying out floating of the step and the 2nd electrode which collect charges from the 1st electrode and maintain the 1st electrode subsequently to the 2nd potential Maintaining the step and the 2nd electrode which give a charge to the 1st electrode to the predetermined potential of another side Maintaining the step and the 2nd electrode which collect charges from the 1st electrode and maintain the 1st electrode subsequently to the 2nd potential to the predetermined potential of aforementioned another side Carrying out floating of the step which gives a charge to the 1st electrode, and the 2nd electrode, the step which collects charges from the 1st electrode and maintains the 1st electrode subsequently to the 2nd potential can be boiled one by one, and it can also constitute so that it may be characterized by having periodically.

[0021] There is especially no limit in the capacitive load driven by the drive circuit and the drive method of a capacitive load of this invention here, and each pulse of positive/negative polarity should just be the capacitive load driven by the police box pulse which appears by turns. For example, flat-surface panels, such as a plasma display panel, an electroluminescence panel (EL panel), and a liquid crystal panel, are mentioned.

[Translation done.]

OPERATION

[Function] By the drive circuit and the drive method of a capacitive load of this invention In case the charges of the 1st electrode are collected and the potential of the 1st electrode is reduced, floating of the 2nd electrode is carried out. The 2nd electrode is made to follow potential change of the 1st electrode using the 1st electrode and the 2nd inter-electrode capacity coupling. In case similarly a charge is returned to the 1st electrode and the potential of the 1st electrode is started, floating of the 2nd electrode can be carried out, and the 2nd electrode can be made to follow potential change of the 1st electrode. Here, a desired potential change can be given to the 2nd electrode without establishing a charge recovery circuit in a 2nd electrode side by combining fixation of the potential of the 2nd electrode, and flattery of the potential change by floating by request.

[Translation done.]

EXAMPLE

[Example] Hereafter, with reference to a drawing, this invention is explained still in detail based on the suitable example of this invention. Here, as a capacitive load driven in the drive circuit of the capacitive load of this invention, a plasma display panel (PDP) is explained as an example like the conventional example. Drawing 1 is the block diagram of the drive circuit of the capacitive load of one example of this invention. Moreover, drawing 2 shows each block of drawing 1 as a basic circuit diagram. In the drive circuit of the capacitive load of this example, the maintenance electrode side maintenance pulse generator consists of only clamping circuits excluding the charge recovery circuit. Other block composition is the same as the block composition of the conventional drive circuit.

[0024] The maintenance electrode-clamp circuit 1 where the drive circuit of this example generates the maintenance pulse for the maintenance electrode 18 in drawing 1 , The priming pulse generator 42 which generates the priming pulse for the maintenance electrode 18, The scanning pulse generator 45 which generates a scanning pulse, and the scanning electrode maintenance pulse generator 46 which generates the maintenance pulse for a scanning electrode, Each scanning electrode 17 constitutes the elimination pulse generator 44 which generates the elimination pulse and priming elimination pulse for a scanning electrode, a scanning pulse and a maintenance pulse, an elimination pulse, etc. from a package or a mixed circuit 47 given individually.

[0025] In drawing 2 , the output of the maintenance electrode-clamp circuit 1 has the switches 159 and 158 for connecting with the maintenance electrode 18 connected in common, and fixing a maintenance electrode to -VS potential or a ground potential periodically, or making it floating. Peak value the priming pulse generator 42 to the maintenance electrode 18 - The priming pulse of VP is given.

[0026] The mixed circuit 47 is equipped with one pair of diodes, 121 and 123, which are arranged every scanning electrode 17 and connected mutually in series, and 122 and 124, and the connection node which connects one pair each of diodes mutually is connected to each scanning electrode 17, respectively. [for example,] By this composition, it functions as the mixed circuit 47 giving a scanning pulse, an elimination pulse, a priming elimination pulse, and the maintenance pulse by the side of a scanning electrode individually to each scanning electrode 17 for every kind of the at a package.

[0027] The scanning pulse generator 45 has one pair of switches, 151 and 153, arranged every scanning electrode 17, and 152 and 154, and the connection node of one pair each of switches is connected to each scanning electrode 17 which corresponds via the mixed circuit 47, respectively. [for example,] Peak value the elimination pulse generator 44 - The priming elimination pulse or peak value of VPE generates the elimination pulse of -VE, and gives these at a package to the scanning electrode 17 via the mixed circuit 47. The scanning electrode maintenance pulse generator 46 has the function to collect the charges of the scanning electrode 17 at the time of the maintenance pulse supply while it consists of scanning electrode-clamp circuit 46a and charge recovery circuit 46b and supplies a maintenance pulse to the scanning electrode 17 via the mixed circuit 47.

[0028] Drawing 3 is the timing chart showing operation of one period in drawing 1 and the maintenance pulse impression period in PDP of drawing 2 . In this drawing, a wave 51 shows the maintenance pulse train by which the maintenance pulse train impressed to the scanning electrode 17 is impressed to a wave 52 by the maintenance electrode 18, respectively. Moreover, a wave 53 is the voltage difference of the scanning electrode 17 and the maintenance electrode 18, and shows the police box maintenance pulse train which is impressed to the discharge space of each display cell, and functions effectively because of charge maintenance. ON of each switch and the timing of OFF are further shown in drawing 3 , and reference marks 60-72 show each operation period in one period in a maintenance conducting period to it.

[0029] As for the inside of a maintenance conducting period, since, as for each switches 151-157 in the scanning pulse generator 45, the priming pulse generator 42, and the elimination pulse generator 44, there is no direct relation to generating and impression of this maintenance pulse, they are maintained at the state of OFF by each.

[0030] First, in the period 60, the switch 158 of the maintenance electrode-clamp circuit 1 is set to ON, therefore, as for the scanning electrode 17 and the maintenance electrode 18, the switch 160 of ON and scanning electrode-clamp circuit 46a is all clamped for it by the ground potential. Moreover, the potential of the charge recovery capacitor 111 in charge recovery circuit 46b is in abbreviation-VS potential at this time.

[0031] In a period 61, the switch 163 of OFF and charge recovery circuit 46b is set to ON for the switch 160 of scanning electrode-clamp circuit 46a with ** which set the switch 158 of the maintenance electrode-clamp circuit 1 to ON. Thereby, via one diode of the coil 102 in charge recovery circuit 46b, diode 126, and one pair each of diodes of the mixed circuit 47, 123 and 124, the charges of the scanning electrode 17 are collected to the charge recovery capacitor 111, and the potential of

a scanning electrode is reduced even in -VS neighborhood by LC resonance. [for example,] At this time, the terminal voltage of the charge recovery capacitor 111 starts to a ground potential to near.
[0032] In a period 62, the switch 161 in OFF and scanning electrode-clamp circuit 46a is again set to ON for the switch 163 in charge recovery circuit 46b, and the potential of the scanning electrode 17 is clamped to the potential of -VS. In a period 63, the switch 162 in OFF and charge recovery circuit 46b is set to ON for a switch 161, the charge of the charge recovery capacitor 111 is returned to the scanning electrode 17 side via the diode, 121 and 122, of another side of the coil 101 in charge recovery circuit 46b, diode 125, and a pair each of diode in the mixed circuit 47, and the potential of the scanning electrode 17 is again started to the ground-potential neighborhood. [for example,] At this time, the potential of the charge recovery capacitor 111 falls even to -VS neighborhood mostly.
[0033] In a period 64, the switch 160 of OFF and scanning electrode-clamp circuit 46a is set to ON for a switch 162, and the potential of the scanning electrode 17 is clamped to a ground potential. Operation from the above-mentioned period 60 to a period 64 is the same as that of operation in the charge recovery type drive circuit of the conventional capacitive load. Here, the maintenance pulse 54 of the negative polarity which has first transition and a trailing edge in periods 61 and 63, respectively is impressed to the scanning electrode 17 before periods 61-63.
[0034] Then, in a period 65, the switch 158 in ON and the maintenance electrode-clamp circuit 1 is made [the switch 160 in scanning electrode-clamp circuit 46a] off for the switch 163 of OFF and charge recovery circuit 46b. By ON of a switch 163, the charges of the scanning electrode 17 are collected by the charge recovery capacitor 111, and the potential of the scanning electrode 17 falls even to -VS neighborhood mostly. Since the switches 157, 158, and 159 which have led to the maintenance electrode 18 at this time are OFF altogether, a maintenance electrode is in floating and the potential of the maintenance electrode 18 is followed by capacity coupling of the maintenance electrode 18 and the scanning electrode 17 at the potential of the scanning electrode 17.
[0035] In a period 66, the switch 159 of OFF and the maintenance electrode-clamp circuit 1 is set to ON for a switch 163, and the potential of the maintenance electrode 18 is clamped to -VS. Subsequently, in a period 67, the potential of the scanning electrode 17 is mostly started even in the ground-potential neighborhood by setting the switch 162 of charge recovery circuit 46b to ON, and returning a charge from the charge recovery capacitor 111. As shown in a wave 51 from a period 65 to the above period 67, the maintenance pulse 57 of the negative polarity which has first transition and a trailing edge in periods 65 and 67 is impressed to the scanning electrode 17. subsequently, a switch 162 is turned OFF in a period 68 -- the scanning electrode 17 is both clamped to a ground potential by setting the switch 160 of scanning electrode-clamp circuit 46a to ON
[0036] In a period 69, the switch 163 of OFF and charge recovery circuit 46b is set to ON for the switch 160 of scanning electrode-clamp circuit 46a, charges are collected to the charge recovery capacitor 111, and the potential of the scanning electrode 17 is again reduced even in -VS neighborhood. Since the switch 159 of the maintenance electrode-clamp circuit 1 is set to ON like the above at this time, the potential of the maintenance electrode 18 is fixed to -VS.
[0037] Subsequently, a switch 163 is made off in a period 70. In a period 71, the switch 159 of the maintenance electrode-clamp circuit 1 is further made off in this state. Simultaneously, the switch 162 of charge recovery circuit 46b is set to ON, a charge is returned to the scanning electrode 17 side from the charge recovery capacitor 111, and the voltage of the scanning electrode 17 is mostly started even to a ground potential. since all the switches that lead to the maintenance electrode 18 are OFF states at this time -- the maintenance electrode 18 -- floating -- it is -- capacity coupling of the maintenance electrode 18 and the scanning electrode 17 -- the potential of the maintenance electrode 18 -- the potential of the scanning electrode 17 -- following -- this -- ** -- it starts in parallel As shown in a wave 51 from a period 69 to the above period 71, the maintenance pulse 58 of the negative polarity which has first transition and a trailing edge in periods 69 and 71, respectively is impressed to the scanning electrode 17.
[0038] Subsequently, in a period 72, the scanning electrode 17 and the maintenance electrode 18 are clamped to a ground potential, respectively by setting the switch 160 of scanning electrode-clamp circuit 46a, and the switch 158 of a maintenance electrode-clamp circuit to ON. As shown in the maintenance electrode 18 in a wave 52 from the above period 65 before a period 72, the maintenance pulse 56 of the negative polarity which has first transition and a trailing edge, respectively is impressed to periods 65 and 72.
[0039] It will set by the above-mentioned periods 60-72. between the scanning electrode 17 and the maintenance electrode 18 The pulse 55 of the negative polarity obtained by the maintenance pulse 54 of negative polarity and the ground potential of the maintenance electrode 18 which are impressed to the scanning electrode 17 so that a wave 53 may see, The pulse 59 of the straight polarity by the ground potential between the maintenance pulses 57 and 58 of the scanning electrode 17 and the negative-potential level in the maintenance pulse 56 impression period of the negative polarity of the maintenance electrode 18 is impressed. That is, the police box maintenance pulse which contributes to maintenance electric discharge is impressed to the discharge space between the scanning electrode 17 in the display cell group 41, and the maintenance electrode 18.
[0040] By repeating periodically drive operation which makes one period from the above period 60 to the period 72, a police box maintenance pulse can be repeated and impressed to the display cell group 41. Therefore, a capacitive load can be driven by charge recovery type drive, without establishing a charge recovery circuit in a maintenance electrode side by using the drive circuit of the above-mentioned example. Thereby, the cost cut by the simplification of a circuit and improvement in the reliability accompanying reduction of the number of elements are realizable.
[0041] In addition, in the composition of the above-mentioned example, the composition which replaces with return of the charge to the charge recovery from a scanning electrode and a scanning electrode, and performs grant of the charge to a scanning electrode and recovery from these, respectively is also employable. In this case, in the period 60 of the beginning of

one period, a scanning electrode and a maintenance electrode are maintained to -VS, respectively, and let potential of a charge recovery capacitor be abbreviation grand level. Hereafter, it replaces with recovery of the aforementioned charge, grant of a charge is replaced with return of a charge, and charges are collected. Also in this case, the same effect as the above-mentioned example is acquired.

[0042] Moreover, in description of the above-mentioned example, although explained with reference to the basic circuit of drawing 2 , the above-mentioned circuit is easily realizable using the present electronics technology. The case where the above-mentioned switch is realized by the field-effect transistor (it outlines Following FET) is illustrated to drawing 4 . In this drawing, reference mark 151F to 158F and 160F to 163F show FET corresponding to 158 and 160 to 163 from the switch 151 of drawing 2 , respectively.

[0043] Although the circuit of drawing 4 has the substantial almost same circuitry as the circuit of drawing 2 , in drawing 4 , FET group 159F which function as a bidirectional switch which consists of P channel FET (159FP) and N channel FET (159FN) are prepared corresponding to the switch 159 of drawing 2 . This prevents that the maintenance electrode 18 sways greatly in the minus direction further from peak value-VS in a period 69.

[0044] Generally, it is known for FET that parasitism diode will be formed in the portion which functions as a switch in parallel. For example, as shown in drawing 5 , the parasitism diode 92 enters in P channel FET91, and the parasitism diode 94 enters in parallel in N channel FET93. In order to prevent the short-circuit current resulting from these parasitism diodes 92 and 94, diodes 129-134 are formed in drawing 4 .

[0045] Peak value of the priming pulse 36 impressed to a maintenance electrode as shown in drawing 11 as an example - VP considers the larger case in the negative direction of being general than peak value-VS of the maintenance pulse 31. When diode 132 was not formed in the maintenance electrode-clamp circuit 1 and FET (157F) of the priming pulse generator 42 is set to ON in order to generate the priming pulse 36, it is -VS power supply line. A short-circuit current will flow to a ->FET(159FN) -> diode 131 ->FET(157F) ->-VP power supply line. Other diodes which are not shown are formed in drawing 2 for the same purpose.

[0046] In addition, the above-mentioned example described as an example the case where the maintenance pulse of negative polarity was impressed to the scanning electrode 17 and the maintenance electrode 18. However, the drive circuit of this invention can be applied, the scanning electrode 17, when reaching and impressing the maintenance pulse of straight polarity to the maintenance electrode 18, respectively, and not only this but when. Drawing 6 is the basic circuit diagram of the drive circuit of the 2nd example showing this case. Corresponding to the coils 101 and 102 in drawing 2 , the charge recovery capacitor 111, diodes 121-126, and each of switches 151-153, coils 201 and 202, the charge recovery capacitor 211, diodes 221-226, and switches 251-263 are arranged. About foundations of operation, since it is the same as that of the case of drawing 2 , detailed explanation is omitted.

[0047] In addition, as for the electrostatic capacity of the charge recovery capacitors 111 and 211, in each above-mentioned example, it is desirable to set up more than the sum total of the electrostatic capacity of the display cell section 41 of PDP which constitutes a load. Moreover, the reactance of a coil takes into consideration the working speed of PDP, and LC resonance frequency of a circuit, and is determined.

[0048] Drawing 7 is drawing showing the composition of the 3rd example of this invention with drawing 2 similarly. Unlike the composition of charge recovery circuit 46b of drawing 2 , in this example, the composition of other composition of charge recovery circuit 46c is the same as that of drawing 2 . In addition, the example of analogous is seen by the patent public notice common No. 81912 [five to] official report in the charge recovery circuit shown in drawing 7 . Drawing 8 is the timing chart showing similarly operation and the driver voltage wave of each switch in drawing 7 with drawing 3 .

[0049] Although not shown in drawing 8 , since, as for during the period which is impressing the maintenance pulse, there was no direct relation to generating and impression of a maintenance pulse, it has kept switches 151-157 each to the OFF state like the 1st example.

[0050] In a period 60, the switch 160 of ON and scanning electrode-clamp circuit 46a is also ON, and the scanning electrode 17 and the maintenance electrode 18 are all clamped for the switch 158 of the maintenance electrode-clamp circuit 1 by the ground potential.

[0051] In a period 61, the switch 160 of scanning electrode-clamp circuit 46a is made off, setting the switch 158 of the maintenance electrode-clamp circuit 1 to ON. Moreover, once set the switch 167 of charge recovery circuit 46c to ON, -VS power supply line is made to flow through the scanning electrode 17 via each diodes 123 and 124 of the coil 105 of charge recovery circuit 46c, and the mixed circuit 47, and the potential of the scanning electrode 17 is reduced. a switch 167 is turned OFF when the potential of the scanning electrode 17 becomes or less -VS/2 (between -VS/2 - -VS and the following -- the same) At this time, each diode 123 of the scanning electrode 17 -> mixture circuit 47 and a 124 -> coil 105 -> diode 138 -> gland, and the current from the scanning electrode 17 flow continuously by operation of the counter-electromotive force generated in a coil 105. Thus, current is passed until the scanning electrode 17 serves as potential of -VS, reducing the power loss of a circuit. Diode 137 has the function to return the power with which the coil 105 remained to -VS power supply line, in cooperation with diode 138 while the voltage by the side of the cathode of diode 137 prevents a bird clapper below to -VS.

[0052] In a period 62, the switch 161 in scanning electrode-clamp circuit 46a is set to ON, and the voltage of the scanning electrode 17 is clamped to -VS. Subsequently, in a period 63, once set the switch 166 of OFF and charge recovery circuit 46c to ON for a switch 161, a gland is made to flow through the scanning electrode 17, and the potential of a scanning electrode is started. A switch 166 is turned OFF when the potential of the scanning electrode 17 becomes or more -VS/2. By operation of the counter-electromotive force generated in a coil 104, the current of each diode 121 of the -VS power supply -> diode 136

-> coil 104 -> mixture circuit 47 and the 122 -> scanning electrode 17, and a scanning electrode flows continuously. Thus, the scanning electrode 17 is started to a ground potential, reducing the power loss of a circuit. Diode 135 has the function to return the power with which the coil 104 remained to -VS power supply, in cooperation with diode 136 while the potential by the side of the anode of diode 135 prevents a bird clapper more than a ground potential.

[0053] In a period 64, the potential of the scanning electrode 17 is clamped to a ground potential by setting the switch 160 in scanning electrode-clamp circuit 46a to ON. The maintenance pulse 84 is impressed to the scanning electrode 17 between a period 61 and a period 63. The foundations of operation from a period 60 to a period 64 are the same as that of circuit operation shown in a patent public notice common 5-81912. Next, based on this invention, the portion which impresses a maintenance pulse to the maintenance electrode 18 by charge recovery circuit 46c is explained.

[0054] First, in a period 65, the switch 158 of OFF and the maintenance electrode-clamp circuit 1 is made off for a switch 160, and the potential of the scanning electrode 17 is once reduced in the negative direction by setting the switch 167 of charge recovery circuit 46c to ON. The operation of charge recovery circuit 46c at this time itself is the same as operation in a period 61, and it will make a switch 167 off by the time of the end of a period 65. However, in a period 65, since the switches 157, 158, and 159 which lead to the maintenance electrode 18 are altogether made into the OFF state, a maintenance electrode is in floating, and as shown in a wave 82, the potential of the maintenance electrode 18 also follows the potential of the scanning electrode 17, and is reduced.

[0055] In a period 66, the potential of the maintenance electrode 18 is clamped to -VS by setting the switch 159 of the maintenance electrode-clamp circuit 1 to ON. Subsequently, in a period 67, the switch 166 of charge recovery circuit 46c is once set to ON, the voltage of the scanning electrode 17 is started in the grand level direction, and a switch 166 is made off before the end of a period 67. The scanning electrode 17 starts to a ground potential within a period 67 by operation of the counter-electromotive force of a coil. As shown in a wave 81 from a period 65 to the above period 67, the maintenance pulse 87 is impressed to the scanning electrode 17. Then, in a period 68, the potential of the scanning electrode 17 is clamped to a ground potential by setting the switch 160 of scanning electrode-clamp circuit 46a to ON.

[0056] In a period 69, the switch 167 of OFF and charge recovery circuit 46c is once set to ON for the switch 160 of scanning electrode-clamp circuit 46a, and the potential of the scanning electrode 17 is again reduced in the negative direction. Since the switch 159 of the maintenance electrode-clamp circuit 1 is set to ON at this time, the potential of a maintenance electrode is clamped by -VS. When the potential of the scanning electrode 17 amounts to or less -VS/2, a switch 167 is turned OFF like the case of a period 61.

[0057] In a period 70, the switch 159 of the maintenance electrode-clamp circuit 1 is still ON. A switch 159 is made off in the next period 71, and all the switches that lead to the maintenance electrode 18 are made into an OFF state. With this, the potential of the scanning electrode 17 is once started in the grand level direction by setting the switch 166 of charge recovery circuit 46c to ON. Since the maintenance electrode 18 is in floating at this time, the potential of the maintenance electrode 18 also follows the potential of the scanning electrode 17, and is started. When the potential of the scanning electrode 17 amounts to or more -VS/2, a switch 166 is made off like a period 63. As shown in a wave 81 from a period 69 to the above period 71, the maintenance pulse 88 is impressed to the scanning electrode 17.

[0058] In a period 72, the scanning electrode 17 and the maintenance electrode 18 are clamped to a ground potential, respectively by setting the switch 160 of scanning electrode-clamp circuit 46a, and the switch 158 of the maintenance electrode-clamp circuit 1 to ON. The maintenance pulse 86 is impressed to the maintenance electrode 18 by operation from the above period 65 to a period 72.

[0059] By the above-mentioned operation, the voltage pulse impressed between a scanning electrode and a maintenance electrode turns into the pulse 85 of the negative polarity by periods 61-63, and the pulse 89 of the straight polarity by periods 67-69, and the police box pulse 83 is impressed between a scanning electrode and a maintenance electrode like the 1st example.

[0060] In a maintenance conducting period, the police box maintenance pulse 83 can be repeated and impressed to the display cell group 41 by repeating periodically operation which makes one period from the period 60 to the period 72. Therefore, also in the 3rd example, the charge recovery type drive of a capacitive load is attained, without establishing a charge recovery circuit in a maintenance electrode side.

[0061] Each above-mentioned example described the drive circuit and the drive method of a capacitive load of this invention by making into an example the case where PDP of form explained with reference to drawing 9 and drawing 10 is driven. However, this invention is applicable not only to the drive of PDP of this form but the drive of AC type PDP of other form. Moreover, it is employable suitable not only for PDP but flat-surface panels, such as other capacitive display panels, for example, an electro luminescent panel, and a liquid crystal panel. Furthermore, generally, this invention is applicable to the drive of any capacitive loads, if impression of the pulse of positive/negative amphipathy is a required capacitive load.

[0062] In the composition of each above-mentioned example, although explained based on the suitable mode of this invention, correction and change various from the composition of the above-mentioned example are possible. For example, although the practical use circuit of drawing 4 showed the example which adopted FET as a switch, it can replace with FET and a bipolar transistor etc. can be adopted. Moreover, it can also constitute so that it may replace with a scanning electrode side and a charge recovery circuit may be established in a maintenance electrode side. In addition, in this case, by PDP, the operating voltage by the side of a maintenance electrode may originate in a high thing, and the cost of passive circuit elements may go up as compared with the case of an example. Furthermore, although each above-mentioned example described the case where a charge recovery circuit was used for all the periods of the first transition of a maintenance pulse, and a trailing

edge, it replaces with this and you may make it use the charge recovery circuit in this invention for a part of first transition of a maintenance pulse, and/or trailing edge.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram of the drive circuit of the capacitive load of the 1st example of this invention.
[Drawing 2] The basic circuit diagram of the drive circuit of the capacitive load of drawing 1 .
[Drawing 3] The timing chart showing the 1st driver voltage wave and switching operation in a drive circuit of an example.
[Drawing 4] The practical use circuit diagram which realizes the basic circuit of drawing 2 .
[Drawing 5] (a) And (b) is the circuit diagram for explanation showing the parasitism diode of FET.
[Drawing 6] The basic circuit diagram of the drive circuit of the capacitive load of the 2nd example of this invention.
[Drawing 7] The basic circuit diagram of the drive circuit of the capacitive load of the 3rd example of this invention.
[Drawing 8] The timing chart showing the driver voltage wave and switching operation in a circuit of drawing 7 .
[Drawing 9] The cross section showing the structure of general alternating current side electric discharge type PDP.
[Drawing 10] The plan showing the electrode disposition of alternating current side electric discharge type PDP of drawing 9 .
[Drawing 11] The timing chart showing the drive wave of alternating current side electric discharge type PDP of drawing 9 .
[Drawing 12] The block diagram of the charge recovery type drive circuit of the conventional capacitive load.
[Drawing 13] The basic circuit diagram of the charge recovery type drive circuit of the capacitive load of drawing 12 .
[Description of Notations]
1 Maintenance Electrode-Clamp Circuit
11 1st Insulating Substrate
12 2nd Insulating Substrate
13, D1 and D2, ..., Dn-1, Dn Train electrode
14 20 Insulating layer
15 21 Septum
16 Fluorescent Substance
17 S1, S2, ..., Sm Scanning electrode
18 C1, C2, ..., Cm Maintenance electrode
19 Bus Electrode
22 Protective Layer
23 Discharge-Gas Space
24 Display Cell
25 Plasma Display Panel
26 Seal Section
31, 32, 54, 55, 84, 85 Maintenance pulse
33 Scanning Pulse
34 Data Pulse
35 Elimination Pulse
36 Priming Pulse
37 Priming Elimination Pulse
41 Display Cell Group
42 Priming Pulse Generator
43 Maintenance Electrode Side Maintenance Pulse Generator
43a, 46a Clamping circuit
43b, 46b, 46c Charge recovery circuit
44 Generating Circuits, Such as Elimination Pulse
45 Scanning Pulse Generator
46 Scanning Electrode Side Maintenance Pulse Generator
47 Mixed Circuit
51 81 Maintenance pulse train of a scanning electrode
52 82 Maintenance pulse train of a maintenance electrode
53 83 Police box maintenance pulse

56 86 Maintenance pulse of a maintenance electrode
54, 57, 84, 87 Maintenance pulse of a scanning electrode
55, 59, 85, 89 Each pulse of a police box pulse
58 88 Maintenance pulse of a scanning electrode
60-72 Period
91 93 FET
92 94 Parasitism diode
201 101-105, 202 Coil
111, 112, 211 Charge recovery capacitor
121-138, 221-226 Diode
151-167, 251-263 Switch
151F-158F, 160F-163F, 159FN, 159FP FET
159F FET group

[Translation done.]

(19) JAPANESE PATENT OFFICE

PATENT ABSTRACTS OF JAPAN

(11) Publication number: **08320669 A**

(43) Date of publication of application: **03.12.96**

(51) Int. Cl **G09G 3/28**
G09G 3/30

(21) Application number: **07127639**

(22) Date of filing: **26.05.95**

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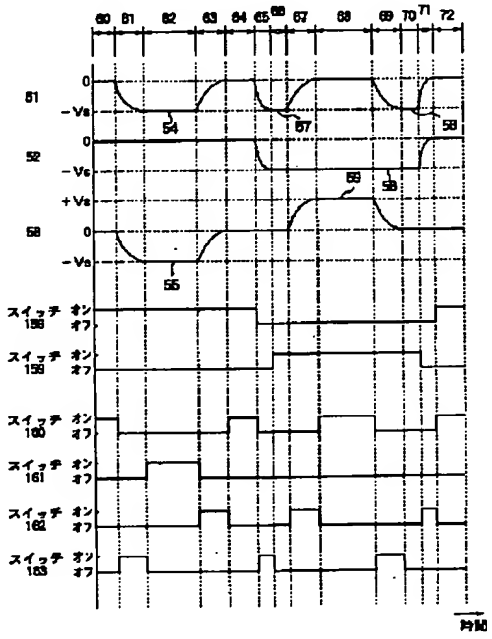
(54) DRIVING CIRCUIT AND DRIVING METHOD FOR CAPACITIVE LOAD

(57) Abstract:

PURPOSE: To simplify an electric charges collection type driving circuit for a capacitive load driven by an alternative pulse.

CONSTITUTION: In a plasma display panel, electric charges are collected from a scanning electrode holding a holding electrode at a ground potential (61), the scanning electrode is held at a negative potential (62), electric charges are returned to the scanning electrode (63), successively it is held at a ground potential (64). Electric charges are collected from the scanning electrode making the holding electrode floating (65), this is once held at a negative potential (66). Successively electric charges are returned to the scanning electrode holding the holding electrode at a negative potential (67). The scanning and the holding electrodes are held at a ground potential (68), electric charges are collected from the scanning electrode (69), the scanning and the holding electrodes are held at a ground potential (70), electric charges are returned to the scanning electrode making the scanning electrode floating (71), and the scanning and the holding electrodes are held at a ground potential (72). A period of repeating this is a holding discharge period.



(19)日本国特許庁（ＪＰ）　(12)特　許　公　報（Ｂ２）　(11)特許番号

第2776298号

(45)発行日　平成10年(1998)７月16日　(24)登録日　平成10年(1998)５月１日

(51)Int.Cl.[6]	識別記号	ＦＩ	
Ｇ０９Ｇ　3/28		Ｇ０９Ｇ　3/28	Ｊ
			Ｈ
3/30		3/30	Ｈ
			Ｊ

請求項の数７(全 12 頁)

(21)出願番号　特願平7－127639

(22)出願日　平成７年(1995)５月26日

(65)公開番号　特開平8－320669

(43)公開日　平成８年(1996)12月３日

審査請求日　平成７年(1995)５月26日

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(58)調査した分野(Int.Cl.[6]，ＤＢ名)
G09G　3/00 － 3/38

(54)【発明の名称】　容量性負荷の駆動回路及び駆動方法

(57)【特許請求の範囲】

【請求項１】　第１及び第２の電極を有する容量性負荷に正負両極性のパルスを交互に印加する、容量性負荷の駆動回路において、

前記第１の電極との間で周期的に電荷の授受を行なう電荷回収回路と、前記電荷の授受の期間以外の少なくとも一部の期間において前記第１の電極を第１又は第２の所定電位にクランプする第１クランプ回路と、前記第２の電極を第３又は第４の所定電位にクランプすると共に一部の前記電荷の授受の期間に対応して前記第２の電極をフローティングさせる第２クランプ回路とを備えることを特徴とする容量性負荷の駆動回路。

【請求項２】　前記第１の所定電位と第３の所定電位とが実質的に等しく、前記第２の所定電位と第４の所定電位とが実質的に等しい、請求項１に記載の容量性負荷の

駆動回路。

【請求項３】　前記電荷回収回路が電荷回収用コンデンサ及びリアクトルを含む、請求項１又は２に記載の容量性負荷の駆動回路。

【請求項４】　前記電荷回収回路がリアクトルの逆起電力を利用する回路として構成される、請求項１又は２に記載の容量性負荷の駆動回路。

【請求項５】　第１及び第２の電極を有する容量性負荷に正負両極性のパルスを交互に印加する、容量性負荷の駆動方法において、

第２の電極を一方の所定電位に維持しつつ、第１の電極から電荷を回収し次いで第１の電極を第１電位に維持するステップ、

第２の電極を前記一方の所定電位に維持しつつ、第１の電極に電荷を戻し次いで第１の電極を第２電位に維持す

るステップ、
第２の電極をフローティングさせつつ、第１の電極から電荷を回収するステップ、
第２の電極を他方の所定電位に維持しつつ、第１の電極に電荷を戻し次いで第１の電極を第２電位に維持するステップ、
第２の電極を前記他方の所定電位に維持しつつ、第１の電極から電荷を回収するステップ、及び、
第２の電極をフローティングさせつつ、第１の電極に電荷を戻し次いで第１の電極を第２の電位に維持するステップを順次に且つ周期的に有することを特徴とする容量性負荷の駆動方法。

【請求項６】　第１及び第２の電極を有する容量性負荷に正負両極性のパルスを交互に印加する、容量性負荷の駆動方法において、
第２の電極を一方の所定電位に維持しつつ、第１の電極に電荷を与え次いで第１の電極を第１電位に維持するステップ、
第２の電極を前記所定電位に維持しつつ、第１の電極から電荷を回収し次いで第１の電極を第２電位に維持するステップ、
第２の電極をフローティングさせつつ、第１の電極に電荷を与えるステップ、
第２の電極を他方の所定電位に維持しつつ、第１の電極から電荷を回収し次いで第１の電極を第２電位に維持するステップ、
第２の電極を前記他方の所定電位に維持しつつ、第１の電極に電荷を与えるステップ、及び、
第２の電極をフローティングさせつつ、第１の電極から電荷を回収し次いで第１の電極を第２の電位に維持するステップを順次に且つ周期的に有することを特徴とする容量性負荷の駆動方法。

【請求項７】　前記容量性負荷がフラットディスプレイパネルであることを特徴とする請求項５又は６に記載の容量性負荷の駆動方法。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、容量性負荷の駆動回路及び駆動方法に関し、特に、従来よりも少ない部品点数で製作できる、電荷回収型の容量性負荷の駆動回路及び方法に関する。

【０００２】

【従来の技術】正負の両極性パルスを必要とする容量性負荷としては、情報端末機器やパーソナルコンピュータ、あるいはテレビジョン等の画像表示装置として用いられる、プラズマディスプレイパネルやエレクトロルミネセントパネル、液晶パネル等のフラットパネルなどがある。従来の容量性負荷の駆動回路として、ここでは、プラズマディスプレイパネル（ＰＤＰ）の駆動回路について述べる。

【０００３】図９は、ＰＤＰの１つの表示セルの列電極に沿う断面図である。同図において、ＰＤＰは、ガラス製の前面の第１絶縁基板１１及び背面の第２絶縁基板１２を備える。第１絶縁基板１１上には、行電極を構成する透明な走査電極１７及び維持電極１８、これら各行電極上に形成されるバス電極１９、電極全体を覆う第１絶縁層２０、及び、表示セルを区画するグリッド状の第１隔壁２１が順次に形成され、更に、第１絶縁層２０を覆ってＭｇＯ等からなる保護層２２が形成されている。

【０００４】第２絶縁基板１２上には、行電極と直交する透明な列電極（データ電極）１３、列電極を覆う第２絶縁層１４、及び、第１隔壁１５と共同して表示セルを区画するグリッド状又はストライプ状の第２隔壁１５が順次に形成され、これら全体を覆って蛍光体１６が塗布されている。第１及び第２隔壁２１、１５により各表示セルを構成する放電ガス空間２３が格子状に形成され、放電ガス空間２３には希ガス等の放電ガスが充填される。

【０００５】図１０は、上記ＰＤＰの全体をその電極構成に着目して示す平面模式図である。ＰＤＰ２５は、前面の第１絶縁基板１１と背面の第２絶縁基板１２とが張合わされた構造を有し、シール部２６により内部空間が気密にシールされている。図面上で、各走査電極１７は符号S_1、S_2、・・・、S_mで、各維持電極１８は符号C_1、C_2、・・・、C_mで、各列電極１３は符号D_1、D_2、・・・、D_{n-1}、D_nで示されている。なお、以下の記述においては、例えばｉ番目の行電極とｊ番目の列電極との交点の表示セル２４をa_{ij}で示す。

【０００６】図１１は、上記ＰＤＰの駆動で用いられる駆動電圧の波形を示す。同図において、波形（Ａ）は維持電極C_1、C_2、・・・、C_mに印加される電圧波形を、波形（Ｂ）は走査電極S_1に印加される電圧波形を、波形（Ｃ）は走査電極S_2に印加される電圧波形を、波形（Ｄ）は走査電極S_mに印加される電圧波形を、波形（Ｅ）は列電極D_1に印加される電圧波形を、波形（Ｆ）は列電極D_2に印加される電圧波形を、波形（Ｇ）は表示セルa_{11}の発光波形を、夫々示している。なお、波形（Ｅ）や波形（Ｆ）で示したデータパルス３４の内の斜線パルスは、書き込むべきデータに従ってパルスの有無が決定されることを示す。

【０００７】以下、上記型式の従来のＰＤＰの動作を簡単に説明する。なお、本明細書中において、パルスの前縁とはパルス電圧の印加が始まってから、略最終電圧に到達するまでのパルス部分、またパルスの後縁とは、パルス電圧の除去が始まってから、パルス電圧がほぼ完全に取り去られるまでのパルス部分を指す。たとえば、正極性パルスにおいては立上がり部分がパルスの前縁であり、立下がり部分がその後縁である。また、負極性パルスにおいては、パルスの立下がり部分が前縁であり、パルスの立上り部分が後縁である。

【０００８】まず、各走査電極S_1、S_2、・・・、S_mに一斉に負極性の消去パルス３５を印加することにより、それまでの維持放電を一旦消去する。つぎに、振幅の大きな負極性のプライミングパルス３６を全ての維持電極C_1、C_2、・・・C_mに印加し、書込み放電の際に放電の種となるプライミング粒子を生成するプライミング放電をパネル全面で行う。次いで、プライミング放電が維持放電にそのままつながらないように、振幅の小さなプライミング消去パルス３７を各走査電極S_1、S_2、・・・、S_mに一斉に印加する。

【０００９】引き続き、書込み放電期間に入り、各走査電極S_1、S_2、・・・、S_mに線順次に走査パルス３３を印加すると同時に、このパルスに同期して各列電極D_1、D_2、・・・、D_{n-1}、D_nにデータパルス３４を印加する。これら走査パルス３３及びデータパルス３４により、所望の表示セルに書込み放電を発生させる。図１１の例では、データ電圧波形（Ｅ）及び（Ｆ）により、表示セルa_{11}及びa_{22}にはデータを書き込み、表示セルa_{12}、a_{21}にはデータを書き込まず、これら以外の表示セルについては、データに従う書き込みが行われる旨が示されている。

【００１０】書込み放電期間が終了すると、各走査電極及び維持電極に夫々負極性の維持パルス３１、３２が交互に印加される。これら維持パルス３１、３２により、走査電極と維持電極との間には、交互に極性が変化する交番維持パルスが印加される。この交番維持パルスにより、以前に書込み放電があった表示セル２４では、走査電極１７と維持電極１８との間で維持放電が発生し、データに従う表示が行なわれる。これら維持パルス３１、３２を印加する回数により表示輝度が制御される。

【００１１】

【発明が解決しようとする課題】上記従来のＰＤＰの駆動回路及び方法では、走査電極及び維持電極に夫々維持パルスが印加されるたびに、主として表示セル部の走査電極と維持電極との間に形成される静電容量の充・放電が行なわれる。このため、表示に本来必要な発光電力以外に、この静電容量の充・放電のための電力、いわゆる無効電力の消費が大きいという欠点があった。

【００１２】上記欠点を除くために、各維持パルス印加の際の静電容量の放電電荷を回収する電荷回収回路を有する電荷回収型駆動回路が提案されている（例えば、特許公開平成５年第２６５３９７号、特許公開昭和６３年第１０１８９７号）。ここで、図１１に示した駆動波形を用いる場合を想定し、図１１、図１２及び図１３を併せて参照して従来の電荷回収型駆動回路について説明する。図１２はこの型式の従来のＰＤＰの駆動回路をブロック図として示し、図１３は図１２の各ブロックを基本的な回路図として示している。図１３では、図１２の要素に対応する要素を同じ参照符号で示した。

【００１３】図１２において、ＰＤＰ駆動回路は、走査電極１７及び維持電極１８を有する表示セル群４１を含むＰＤＰ２５の駆動のために設けられている。ＰＤＰ駆動回路は、プライミングパルス３６を維持電極１８に印加するプライミングパルス発生回路４２、電荷回収回路を含み、維持パルス３１を維持電極１８に印加する維持電極側維持パルス発生回路４３、消去パルス３５やプライミング消去パルス３７を生成する消去パルス発生回路４４、走査パルス３３を生成する走査パルス発生回路４５、電荷回収回路を含み、走査電極側の維持パルス３２を生成する走査電極側維持パルス発生回路４６、及び、走査電極側の維持パルス３２、走査パルス３３、消去パルス３５等をその機能に対応して各走査電極１７に一括又は個別に印加する混合回路４７を有する。

【００１４】図１３において、維持電極側維持パルス発生回路４３は、クランプ回路４３ａと電荷回収回路４３ｂとから構成され、また、走査電極側維持パルス発生回路４６も、同様に、クランプ回路４６ａと電荷回収回路４６ｂとから構成される。各クランプ回路４３ａ、４６ａは、対応する電極を周期的に電源電位－V_S又は接地（グランド）電位に固定（クランプ）するスイッチング回路として構成され、また、各電荷回収回路４３ｂ、４６ｂは、ＬＣ共振回路を構成するコイル１０１、１０２、１０３及び電荷回収コンデンサ１１１、１１２から構成される。各電荷回収回路４３ｂ、４６ｂは、対応する走査電極１７又は維持電極１８に蓄積された電荷をこれらから回収し、また、その電荷をこれらに戻す機能を有し、この機能によって無効電力の消費を抑える。

【００１５】上記のように、電荷回収回路４３ｂ、４６ｂは、一般に、維持電極１８側および走査電極１７側のそれぞれに設けられ、これら電極に蓄積される電荷を一旦回収し、また、この電荷を対応する電極に再び戻す。ところで、これら電荷回収回路は、スイッチング回路及びＬＣ共振回路から成り、回路構成が複雑でその製作費用もかさみ、駆動回路全体のコストを大きく上昇させるという欠点がある。

【００１６】特に、維持電極側では電圧振幅が高いプライミングパルス３６を扱う。このため、維持電極側維持パルス発生回路４３内に含まれる電荷回収回路４３ｂにも高耐電圧素子を用いる必要がある。このような高耐電圧素子は高価であり、駆動回路の更なるコスト上昇を引き起こす。

【００１７】本発明の目的は、電荷回収回路を有する従来の容量性負荷の駆動回路を改良し、もって、簡素な構成を採用することで、低価格で製作可能な、電荷回収回路を有する容量性負荷の駆動回路を提供することにある。

【００１８】

【課題を解決するための手段】上記目的を達成するために、本発明の容量性負荷の駆動回路は第１及び第２の電極を有する容量性負荷に正負両極性のパルスを交互に印

加する、容量性負荷の駆動回路において、前記第１の電極との間で周期的に電荷の授受を行なう電荷回収回路と、前記電荷の授受の期間以外の少なくとも一部の期間において前記第１の電極を第１又は第２の所定電位にクランプする第１クランプ回路と、前記第２の電極を第３又は第４の所定電位にクランプすると共に一部の前記電荷の授受の期間に対応して前記第２の電極をフローティングさせる第２クランプ回路とを備えることを特徴とする。

【００１９】また、本発明の容量性負荷の駆動方法は、第１及び第２の電極を有する容量性負荷に正負両極性のパルスを交互に印加する、容量性負荷の駆動方法において、第２の電極を一方の所定電位に維持しつつ、第１の電極から電荷を回収し次いで第１の電極を第１電位に維持するステップ、第２の電極を前記所定電位に維持しつつ、第１の電極に電荷を戻し次いで第１の電極を第２電位に維持するステップ、第２の電極をフローティングさせつつ、第１の電極から電荷を回収するステップ、第２の電極を他方の所定電位に維持しつつ、第１の電極に電荷を戻し次いで第１の電極を第２電位に維持するステップ、第２の電極を前記他方の所定電位に維持しつつ、第１の電極から電荷を回収するステップ、及び、第２の電極をフローティングさせつつ、第１の電極に電荷を戻し次いで第１の電極を第２の電位に維持するステップを順次に且つ周期的に有することを特徴とする。

【００２０】上記に代えて、本発明のプラズマディスプレイパネルの駆動方法は、第１及び第２の電極を有する容量性負荷に正負両極性のパルスを交互に印加する、容量性負荷の駆動方法において、第２の電極を一方の所定電位に維持しつつ、第１の電極に電荷を与え次いで第１の電極を第１電位に維持するステップ、第２の電極を前記所定電位に維持しつつ、第１の電極から電荷を回収し次いで第１の電極を第２電位に維持するステップ、第２の電極をフローティングさせつつ、第１の電極に電荷を与えるステップ、第２の電極を他方の所定電位に維持しつつ、第１の電極から電荷を回収し次いで第１の電極を第２電位に維持するステップ、第２の電極を前記他方の所定電位に維持しつつ、第１の電極に電荷を与えるステップ、及び、第２の電極をフローティングさせつつ、第１の電極から電荷を回収し次いで第１の電極を第２の電位に維持するステップを順次に且つ周期的に有することを特徴とするように構成することも出来る。

【００２１】ここで、本発明の容量性負荷の駆動回路及び駆動方法で駆動される容量性負荷に特に制限はなく、正負極性の各パルスが交互に現れる交番パルスで駆動される容量性負荷であればよい。例えば、プラズマディスプレイパネル、エレクトロルミネッセンスパネル（ＥＬパネル）、液晶パネル等の平面パネルが挙げられる。

【００２２】

【作用】本発明の容量性負荷の駆動回路及び駆動方法で

は、第１の電極の電荷を回収して第１の電極の電位を引き下げる際に第２の電極をフローティングさせ、第１の電極及び第２の電極間の容量結合を利用して第２の電極を第１の電極の電位変動に追従させ、同様に、第１の電極に電荷を戻して第１の電極の電位を立ち上げる際に第２の電極をフローティングさせ、第２の電極を第１の電極の電位変動に追従させることが出来る。ここで、第２の電極の電位の固定及びフローティングによる電位変動の追従を所望により組み合せることにより、第２の電極側に電荷回収回路を設けないで、所望の電位変動を第２の電極に与えることが出来る。

【００２３】

【実施例】以下、図面を参照し、本発明の好適な実施例に基づいて本発明を更に詳細に説明する。ここで、本発明の容量性負荷の駆動回路で駆動される容量性負荷としては、従来例と同様に、プラズマディスプレイパネル（ＰＤＰ）を例として説明する。図１は、本発明の１実施例の容量性負荷の駆動回路のブロック図である。また、図２は図１の各ブロックを基本回路図として示している。本実施例の容量性負荷の駆動回路では、維持電極側維持パルス発生回路が、電荷回収回路を含まず、単にクランプ回路のみで構成されている。その他のブロック構成は従来の駆動回路のブロック構成と同様である。

【００２４】図１において、本実施例の駆動回路は、維持電極１８のための維持パルスを発生させる維持電極クランプ回路１と、維持電極１８のためのプライミングパルスを発生させるプライミングパルス発生回路４２と、走査パルスを発生させる走査パルス発生回路４５と、走査電極のための維持パルスを発生させる走査電極維持パルス発生回路４６と、走査電極のための消去パルスやプライミング消去パルスを発生させる消去パルス発生回路４４と、走査パルス、維持パルス及び消去パルス等を各走査電極１７に一括又は個別に与える混合回路４７とから構成される。

【００２５】図２において、維持電極クランプ回路１の出力は、共通に接続された維持電極１８に接続され、維持電極を周期的に、－V_S電位若しくはグランド電位に固定し、或いは、フローティング状態にするためのスイッチ１５９、１５８を有する。プライミングパルス発生回路４２は、維持電極１８に波高値が－V_Pのプライミングパルスを与える。

【００２６】混合回路４７は、各走査電極１７毎に配設され相互に直列に接続される１対のダイオード例えば１２１、１２３及び１２２、１２４を備え、各１対のダイオードを相互に接続する接続ノードが夫々各走査電極１７に接続されている。この構成により、混合回路４７は、走査パルス、消去パルス、プライミング消去パルス及び走査電極側の維持パルスを、その種類毎に、各走査電極１７に個別に又は一括に与えるように機能する。

【００２７】走査パルス発生回路４５は、各走査電極１

７毎に配設される１対のスイッチ例えば１５１、１５３及び１５２、１５４を有し、各１対のスイッチの接続ノードは、混合回路４７を経由して対応する各走査電極１７に夫々接続される。消去パルス発生回路４４は、波高値が－V_{PE}のプライミング消去パルス又は波高値が－V_Eの消去パルスを生成し、これらを、混合回路４７を経由して走査電極１７に一括に与える。走査電極維持パルス発生回路４６は、走査電極クランプ回路４６ａ及び電荷回収回路４６ｂから構成され、混合回路４７を経由して走査電極１７に維持パルスを供給すると共に、その維持パルス供給時に走査電極１７の電荷を回収する機能を有する。

【００２８】図３は、図１及び図２のＰＤＰにおける維持パルス印加期間内の１つの周期の動作を示すタイミング図である。同図において、波形５１は走査電極１７に印加される維持パルス列を、波形５２は維持電極１８に印加される維持パルス列を、夫々示す。また、波形５３は、走査電極１７と維持電極１８の電圧差であって、各表示セルの放電空間に印加されて電荷維持のために有効に機能する交番維持パルス列を示す。図３には、更に各スイッチのオン及びオフのタイミングが示されており、維持放電期間中の１つの周期内の各作動期間を参照符号６０～７２で示している。

【００２９】維持放電期間中は、走査パルス発生回路４５、プライミングパルス発生回路４２、及び、消去パルス発生回路４４内の各スイッチ１５１～１５７は、この維持パルスの発生及び印加には直接関係がないので、何れもオフの状態に保たれる。

【００３０】まず、期間６０では、維持電極クランプ回路１のスイッチ１５８がオン、走査電極クランプ回路４６ａのスイッチ１６０がオンとしてあり、従って、走査電極１７及び維持電極１８は、何れもグランド電位にクランプされている。また、このとき、電荷回収回路４６ｂ内の電荷回収コンデンサ１１１の電位は、略－V_S電位にある。

【００３１】期間６１では、維持電極クランプ回路１のスイッチ１５８をオンとしたたまま、走査電極クランプ回路４６ａのスイッチ１６０をオフ、電荷回収回路４６ｂのスイッチ１６３をオンとする。これにより、電荷回収回路４６ｂ内のコイル１０２、ダイオード１２６、及び、混合回路４７の各１対のダイオードの内の一方のダイオード例えば１２３、１２４を経由して、走査電極１７の電荷を電荷回収コンデンサ１１１に回収し、ＬＣ共振により走査電極の電位を－V_S附近に迄引き下げる。このとき、電荷回収コンデンサ１１１の端子電圧はグランド電位に近くまで立ち上がる。

【００３２】期間６２では、電荷回収回路４６ｂ内のスイッチ１６３を再びオフ、走査電極クランプ回路４６ａ内のスイッチ１６１をオンとし、走査電極１７の電位を－VSの電位にクランプする。期間６３では、スイッチ１６１をオフ、電荷回収回路４６ｂ内のスイッチ１６２をオンとして、電荷回収回路４６ｂ内のコイル１０１、ダイオード１２５及び混合回路４７内の各一対のダイオードの内の他方のダイオード例えば１２１、１２２を経由して、電荷回収コンデンサ１１１の電荷を走査電極１７側に戻し、走査電極１７の電位を再びグランド電位附近まで立ち上げる。このとき、電荷回収コンデンサ１１１の電位は、ほぼ－V_S附近に迄低下する。

【００３３】期間６４では、スイッチ１６２をオフ、走査電極クランプ回路４６ａのスイッチ１６０をオンとして、走査電極１７の電位をグランド電位にクランプする。上記の期間６０から期間６４までの動作は、従来の容量性負荷の電荷回収型駆動回路における動作と同様である。ここで、期間６１から６３迄の間において、走査電極１７には、期間６１及び６３に夫々前縁及び後縁を有する負極性の維持パルス５４が印加される。

【００３４】引き続き、期間６５では、走査電極クランプ回路４６ａ内のスイッチ１６０をオフ、電荷回収回路４６ｂのスイッチ１６３をオン、維持電極クランプ回路１内のスイッチ１５８をオフとする。スイッチ１６３のオンによって、走査電極１７の電荷が電荷回収コンデンサ１１１に回収され、走査電極１７の電位はほぼ－VS附近に迄低下する。このとき維持電極１８につながっているスイッチ１５７、１５８、１５９が全てオフであるので、維持電極はフローティング状態にあり、維持電極１８と走査電極１７との容量結合により、維持電極１８の電位は走査電極１７の電位に追従する。

【００３５】期間６６では、スイッチ１６３をオフ、維持電極クランプ回路１のスイッチ１５９をオンとして、維持電極１８の電位を－V_Sにクランプする。次いで、期間６７では、電荷回収回路４６ｂのスイッチ１６２をオンとし、電荷回収コンデンサ１１１から電荷を戻すことにより、走査電極１７の電位をほぼグランド電位附近にまで立ち上げる。以上の期間６５から期間６７の間において、波形５１中に示されるように、走査電極１７には期間６５及び６７に前縁及び後縁を有する負極性の維持パルス５７が印加される。次いで、期間６８で、スイッチ１６２をオフにする共に、走査電極クランプ回路４６ａのスイッチ１６０をオンとして、走査電極１７をグランド電位にクランプする。

【００３６】期間６９では、走査電極クランプ回路４６ａのスイッチ１６０をオフ、電荷回収回路４６ｂのスイッチ１６３をオンとし、電荷回収コンデンサ１１１に電荷を回収して、走査電極１７の電位を再び－V_S附近に迄引き下げる。このとき維持電極クランプ回路1のスイッチ１５９は前記の如くオンとしてあるので、維持電極１８の電位は－V_Sに固定されたままである。

【００３７】次いで、期間７０でスイッチ１６３をオフとする。この状態で更に期間７１において、維持電極クランプ回路１のスイッチ１５９をオフとする。同時に、

電荷回収回路４６ｂのスイッチ１６２をオンとし、電荷回収コンデンサ１１１から走査電極１７側に電荷を戻して、走査電極１７の電圧をほぼグランド電位に迄立ち上げる。このとき、維持電極１８につながるスイッチは全てオフ状態であるため、維持電極１８はフローティング状態にあり、維持電極１８と走査電極１７との容量結合により、維持電極１８の電位は走査電極１７の電位に追従しこれにと並行して立ち上がる。以上の期間６９から期間７１の間において、波形５１中に示されるように、走査電極１７には期間６９及び７１に夫々前縁及び後縁を有する負極性の維持パルス５８が印加される。

【００３８】次いで、期間７２では、走査電極クランプ回路４６ａのスイッチ１６０及び維持電極クランプ回路のスイッチ１５８を夫々オンとして、走査電極１７及び維持電極１８を夫々グランド電位にクランプする。以上の期間６５から期間７２までの間において、維持電極１８には、波形５２中に示されるように、期間６５及び７２に夫々前縁及び後縁を有する負極性の維持パルス５６が印加される。

【００３９】上記の期間６０から７２迄において、走査電極１７と維持電極１８との間には、波形５３にみられるように、走査電極１７に印加される負極性の維持パルス５４と維持電極１８のグランド電位とにより得られる負極性のパルス５５と、走査電極１７の維持パルス５７及び５８の間のグランド電位と維持電極１８の負極性の維持パルス５６印加期間中の負電位レベルとによる正極性のパルス５９とが印加される。即ち、表示セル群４１内の走査電極１７と維持電極１８との間の放電空間には、維持放電に寄与する交番維持パルスが印加される。

【００４０】以上の期間６０から期間７２までを１周期とする駆動動作を周期的に繰り返すことにより、表示セル群４１に交番維持パルスを繰り返し印加することが出来る。従って、上記実施例の駆動回路を用いることにより、維持電極側に電荷回収回路を設けることなく、容量性負荷を、電荷回収型駆動によって駆動することができる。これにより、回路の簡素化によるコストダウンと、要素数の減少に伴う信頼性の向上とを実現することができる。

【００４１】なお、上記実施例の構成において、走査電極からの電荷回収及び走査電極への電荷の戻しに代えて夫々、走査電極への電荷の付与及びこれらからの回収を行なう構成も採用できる。この場合、１周期の最初の期間６０においては、走査電極及び維持電極を夫々－V_Sに維持し、且つ、電荷回収コンデンサの電位を略グランドレベルとしておく。以下、前記電荷の回収に代えて電荷の付与を、電荷の戻しに代えて電荷の回収を行なう。この場合にも上記実施例と同様な効果が得られる。

【００４２】また、上記実施例の記述では、図２の基本回路を参照して説明したが、現在のエレクトロニクス技術を用いて上記回路は容易に実現できる。上記スイッチ

を電界効果トランジスタ（以下ＦＥＴと略記する）で実現した場合を図４に例示する。同図においては、図２のスイッチ１５１から１５８、１６０から１６３にそれぞれ対応するＦＥＴを、参照符号１５１Ｆから１５８Ｆ及び１６０Ｆから１６３Ｆで夫々示している。

【００４３】図４の回路は図２の回路と実質的にほぼ同じ回路構成を有するが、図４では、ＰチャネルＦＥＴ（１５９ＦＰ）及びＮチャネルＦＥＴ（１５９ＦＮ）から成る双方向スイッチとして機能するＦＥＴ群１５９Ｆを図２のスイッチ１５９に対応して設けている。これにより、期間６９において維持電極１８が波高値－V_Sよりさらにマイナス方向に大きく振れることを防止する。

【００４４】一般に、ＦＥＴでは、スイッチとして機能する部分に寄生ダイオードが並列に形成されることが知られている。例えば図５に示すように、ＰチャネルＦＥＴ９１では寄生ダイオード９２が、ＮチャネルＦＥＴ９３では寄生ダイオード９４が並列に入る。これら寄生ダイオード９２、９４に起因する短絡電流を防止するため、図４では、ダイオード１２９～１３４を設けてある。

【００４５】例として、図１１に示したような、維持電極に印加されるプライミングパルス３６の波高値－V_Pが、維持パルス３１の波高値－V_Sより負方向に大きい一般的な場合を考える。維持電極クランプ回路１内にダイオード１３２を設けないと、プライミングパルス３６を発生させるためにプライミングパルス発生回路４２のＦＥＴ（１５７Ｆ）をオンとしたときに、－V_S電源ライン →ＦＥＴ（１５９ＦＮ）→ダイオード１３１→ＦＥＴ（１５７Ｆ）→－V_P電源ラインへと短絡電流が流れてしまう。図２には示されていない他のダイオードも同様な目的で設けられている。

【００４６】なお、上記実施例では、走査電極１７及び維持電極１８に負極性の維持パルスを印加する場合を例として述べた。しかし、本発明の駆動回路は、これに限らず、走査電極１７及び及び維持電極１８に夫々正極性の維持パルスを印加する場合にも適用できる。図６は、この場合を示す第２の実施例の駆動回路の基本回路図である。図２におけるコイル１０１、１０２、電荷回収コンデンサ１１１、ダイオード１２１～１２６、及び、スイッチ１５１～１５３のそれぞれに対応して、コイル２０１、２０２、電荷回収コンデンサ２１１、ダイオード２２１～２２６、及び、スイッチ２５１～２６３を配置している。動作の基本については、図２の場合と同様であるので、詳細な説明は略する。

【００４７】なお、上記各実施例において、電荷回収コンデンサ１１１、２１１の静電容量は、負荷を構成するＰＤＰの表示セル部４１の静電容量の合計以上に設定することが好ましい。また、コイルのリアクタンスは、ＰＤＰの動作速度及び回路のＬＣ共振周波数を勘案して決定される。

【００４８】図７は、本発明の第３の実施例の構成を図２と同様に示す図である。この実施例では、電荷回収回路４６ｃの構成が図２の電荷回収回路４６ｂの構成と異なり、その他の構成は図２と同様である。なお、図７に示した電荷回収回路に類似の例は、特許公告平５－８１９１２号公報にみられる。図８は、図７における各スイッチの動作及び駆動電圧波形を図３と同様に示すタイミング図である。

【００４９】図８には示されていないが、第１の実施例と同様に、維持パルスを印加している期間中は、スイッチ１５１～１５７は、維持パルスの発生及び印加には直接関係がないので、何れもオフ状態に保ったままである。

【００５０】期間６０では、維持電極クランプ回路１のスイッチ１５８はオン、走査電極クランプ回路４６ａのスイッチ１６０もオンであり、走査電極１７及び維持電極１８は何れもグランド電位にクランプされる。

【００５１】期間６１では、維持電極クランプ回路１のスイッチ１５８をオンとしたまま、走査電極クランプ回路４６ａのスイッチ１６０をオフとする。また、電荷回収回路４６ｃのスイッチ１６７を一旦オンとし、電荷回収回路４６ｃのコイル１０５、混合回路４７の各ダイオード１２３及び１２４を経由して、走査電極１７を－V_S電源ラインに導通させ走査電極１７の電位を引き下げる。走査電極１７の電位が－V_S／２以下（－V_S／２～－V_Sの間、以下同様）になった時点でスイッチ１６７をオフにする。このとき、コイル１０５に発生する逆起電力の作用により、走査電極１７→混合回路４７の各ダイオード１２３及び１２４→コイル１０５→ダイオード１３８→グランドと、走査電極１７からの電流は継続して流れる。このようにして、回路の電力損失を低減しながら走査電極１７が－V_Sの電位となる迄電流を流す。ダイオード１３７は、ダイオード１３７のカソード側の電圧が－V_S以下になることを防ぐとともに、ダイオード１３８と協同して、コイル１０５の余った電力を－V_S電源ラインに戻す機能を有する。

【００５２】期間６２では、走査電極クランプ回路４６ａ内のスイッチ１６１をオンとし、走査電極１７の電圧を－V_Sにクランプする。次いで、期間６３では、スイッチ１６１をオフ、電荷回収回路４６ｃのスイッチ１６６を一旦オンとし、走査電極１７をグランドに導通させて走査電極の電位を立ち上げる。走査電極１７の電位が－V_S／２以上となった時点でスイッチ１６６をオフにする。コイル１０４に発生する逆起電力の作用により、－V_S電源→ダイオード１３６→コイル１０４→混合回路４７の各ダイオード１２１及び１２２→走査電極１７と、走査電極の電流は継続して流れる。このようにして、回路の電力損失を低減しつつ走査電極１７をグランド電位まで立ち上げる。ダイオード１３５は、ダイオード１３５のアノード側の電位がグランド電位以上になることを防ぐとともに、ダイオード１３６と協同して、コイル１０４の余った電力を－V_S電源に戻す機能を有する。

【００５３】期間６４では、走査電極クランプ回路４６ａ内のスイッチ１６０をオンとして、走査電極１７の電位をグランド電位にクランプする。期間６１から期間６３の間で走査電極１７には維持パルス８４が印加される。期間６０から期間６４までの動作の基本は、特許公告平５－８１９１２に示されている回路動作と同様である。次に、本発明に基づいて、電荷回収回路４６ｃにより維持電極１８に維持パルスを印加する部分について説明する。

【００５４】まず、期間６５では、スイッチ１６０をオフ、維持電極クランプ回路１のスイッチ１５８をオフとし、また、電荷回収回路４６ｃのスイッチ１６７を一旦オンとして、走査電極１７の電位を負方向に引き下げる。このときの電荷回収回路４６ｃの動作自体は期間６１での動作と同じであり、期間６５の終了時までにスイッチ１６７をオフとする。しかし、期間６５では、維持電極１８につながるスイッチ１５７、１５８、１５９は全てオフ状態にしてあるので、維持電極はフローティング状態にあり、波形８２に示すように、維持電極１８の電位も、走査電極１７の電位に追従して引き下げられる。

【００５５】期間６６では、維持電極クランプ回路１のスイッチ１５９をオンとして維持電極１８の電位を－V_Sにクランプする。次いで、期間６７では、電荷回収回路４６ｃのスイッチ１６６を一旦オンとし、走査電極１７の電圧をグランドレベル方向に立ち上げ、期間６７の終了前にスイッチ１６６をオフとする。コイルの逆起電力の作用により期間６７内で走査電極１７はグランド電位に立ち上がる。以上の期間６５から期間６７の間において、波形８１に示すように、走査電極１７に維持パルス８７が印加される。引き続き、期間６８では、走査電極クランプ回路４６ａのスイッチ１６０をオンとして、走査電極１７の電位をグランド電位にクランプする。

【００５６】期間６９では、走査電極クランプ回路４６ａのスイッチ１６０をオフ、電荷回収回路４６ｃのスイッチ１６７を一旦オンとして、走査電極１７の電位を再び負方向に引き下げる。このとき維持電極クランプ回路１のスイッチ１５９はオンとしてあるので、維持電極の電位は－V_Sにクランプされている。走査電極１７の電位が－V_S／２以下に達した時点で、期間６１の場合と同様に、スイッチ１６７をオフにする。

【００５７】期間７０では、維持電極クランプ回路１のスイッチ１５９はまだオンのままである。次の期間７１でスイッチ１５９をオフとし、維持電極１８につながるスイッチを全てオフ状態にする。これとともに、電荷回収回路４６ｃのスイッチ１６６を一旦オンとして走査電極１７の電位をグランドレベル方向に立ち上げる。この

とき、維持電極１８はフローティング状態にあるので、維持電極１８の電位も走査電極１７の電位に追従して立ち上げられる。走査電極１７の電位が－Vs／２以上に達した時点で、期間６３と同様に、スイッチ１６６をオフとする。以上の期間６９から期間７１の間において、波形８１に示すように走査電極１７に維持パルス８８が印加される。

【００５８】期間７２では、走査電極クランプ回路４６ａのスイッチ１６０及び維持電極クランプ回路１のスイッチ１５８を夫々オンとして、走査電極１７及び維持電極１８を夫々グランド電位にクランプする。以上の期間６５から期間７２までの動作により、維持電極１８には維持パルス８６が印加される。

【００５９】上記の作動により、走査電極と維持電極の相互間に印加される電圧パルスは、期間６１から６３迄の負極性のパルス８５、及び、期間６７から６９迄の正極性のパルス８９となり、第１の実施例と同様に、走査電極と維持電極との間に交番パルス８３が印加される。

【００６０】維持放電期間において、期間６０から期間７２までを１周期とする動作を周期的に繰り返すことにより、表示セル群４１に交番維持パルス８３を繰り返し印加することが出来る。従って、第３の実施例においても、維持電極側に電荷回収回路を設けることなく、容量性負荷の電荷回収型駆動が可能となる。

【００６１】上記各実施例では、図９及び図１０を参照して説明した型式のＰＤＰを駆動する場合を例として、本発明の容量性負荷の駆動回路及び駆動方法を記述した。しかし、本発明は、この型式のＰＤＰの駆動に限らず、他の型式のＡＣ型ＰＤＰの駆動にも適用できる。また、ＰＤＰに限らず、その他の容量性の表示パネル、例えばエレクトロルミネセントパネルや液晶パネル等の平面パネルにも好適に採用できる。更に、本発明は、一般的に、正負両極性のパルスの印加が必要な容量性負荷であれば、いかなる容量性負荷の駆動にも適用できる。

【００６２】上記各実施例の構成においては、本発明の好適な態様に基づいて説明したが、上記実施例の構成から種々の修正及び変更が可能である。例えば、図４の実用回路では、スイッチとしてＦＥＴを採用した例を示したが、ＦＥＴに代えてバイポーラトランジスタ等を採用することが出来る。また、走査電極側に代えて維持電極側に電荷回収回路を設けるように構成することも出来る。なお、この場合、ＰＤＰでは、維持電極側の動作電圧が高いことに起因して、実施例の場合に比して回路部品のコストが上昇することがある。更に、上記各実施例では、維持パルスの前縁及び後縁の期間の全てに電荷回収回路を用いる場合について述べたが、これに代えて、維持パルスの前縁及び／又は後縁の一部に、本発明における電荷回収回路を用いるようにしてもよい。

【００６３】

【発明の効果】以上説明したように、本発明の容量性負荷の駆動回路及び駆動方法によると、容量性負荷に印加する交番パルスの発生回路を簡素な回路構成で実現できるので、本発明は、容量性負荷の電荷回収型駆動回路のコストを低く抑え、また、回路の信頼性を向上させた顕著な効果を奏する。

【図面の簡単な説明】

【図１】本発明の第１の実施例の容量性負荷の駆動回路のブロック図。

【図２】図１の容量性負荷の駆動回路の基本回路図。

【図３】第１の実施例の駆動回路における駆動電圧波形及びスイッチング動作を示すタイミング図。

【図４】図２の基本回路を実現する実用回路図。

【図５】（ａ）及び（ｂ）は、ＦＥＴの寄生ダイオードを示す説明用の回路図。

【図６】本発明の第２の実施例の容量性負荷の駆動回路の基本回路図。

【図７】本発明の第３の実施例の容量性負荷の駆動回路の基本回路図。

【図８】図７の回路における駆動電圧波形及びスイッチング動作を示すタイミング図。

【図９】一般的な交流面放電型ＰＤＰの構造を示す断面図。

【図１０】図９の交流面放電型ＰＤＰの電極配置を示す平面図。

【図１１】図９の交流面放電型ＰＤＰの駆動波形を示すタイミング図。

【図１２】従来の容量性負荷の電荷回収型駆動回路のブロック図。

【図１３】図１２の容量性負荷の電荷回収型駆動回路の基本回路図。

【符号の説明】

１　維持電極クランプ回路
１１　第１絶縁基板
１２　第２絶縁基板
１３、D_1、D_2、・・・、D_{n-1}、D_n　列電極
１４、２０　絶縁層
１５、２１　隔壁
１６　蛍光体
１７、S_1、S_2、・・・、S_m　走査電極
１８、C_1、C_2、・・・、C_m　維持電極
１９　バス電極
２２　保護層
２３　放電ガス空間
２４　表示セル
２５　プラズマディスプレイパネル
２６　シール部
３１、３２、５４、５５、８４、８５　維持パルス
３３　走査パルス
３４　データパルス
３５　消去パルス

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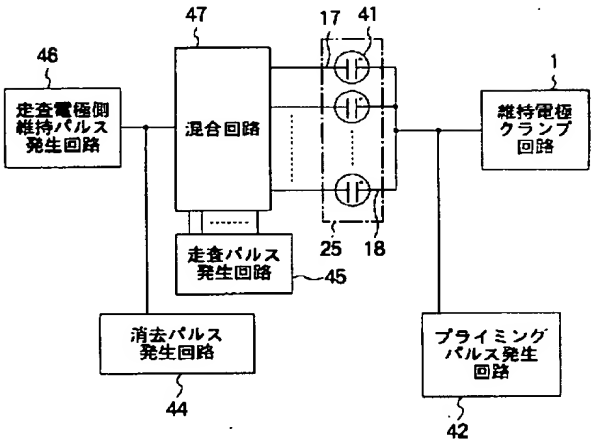
３６　プライミングパルス
３７　プライミング消去パルス
４１　表示セル群
４２　プライミングパルス発生回路
４３　維持電極側維持パルス発生回路
４３ａ、４６ａ　クランプ回路
４３ｂ、４６ｂ、４６ｃ　電荷回収回路
４４　消去パルスなどの発生回路
４５　走査パルス発生回路
４６　走査電極側維持パルス発生回路
４７　混合回路
５１、８１　走査電極の維持パルス列
５２、８２　維持電極の維持パルス列
５３、８３　交番維持パルス

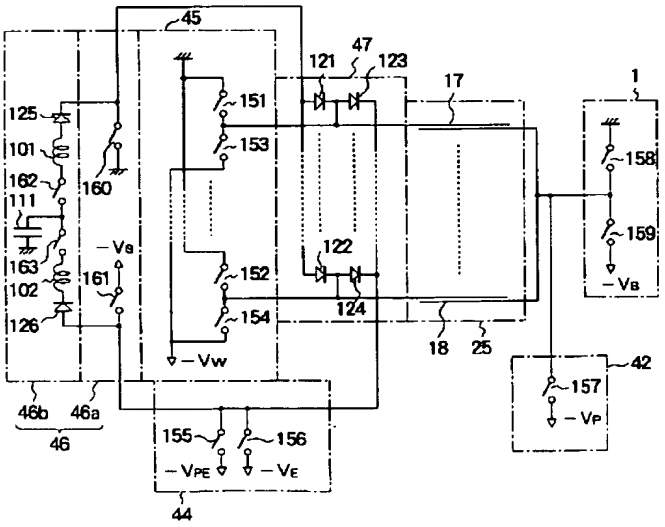
18

５６、８６　維持電極の維持パルス
５４、５７、８４、８７　走査電極の維持パルス
５５、５９、８５、８９　交番パルスの各パルス
５８、８８　走査電極の維持パルス
６０～７２　期間
９１、９３　ＦＥＴ
９２、９４　寄生ダイオード
１０１～１０５、２０１、２０２　コイル
１１１、１１２、２１１　電荷回収コンデンサ
１２１～１３８、２２１～２２６　ダイオード
１５１～１６７、２５１～２６３　スイッチ
１５１Ｆ～１５８Ｆ、１６０Ｆ～１６３Ｆ、１５９ＦＮ、１５９ＦＰ　ＦＥＴ
１５９Ｆ　ＦＥＴ群

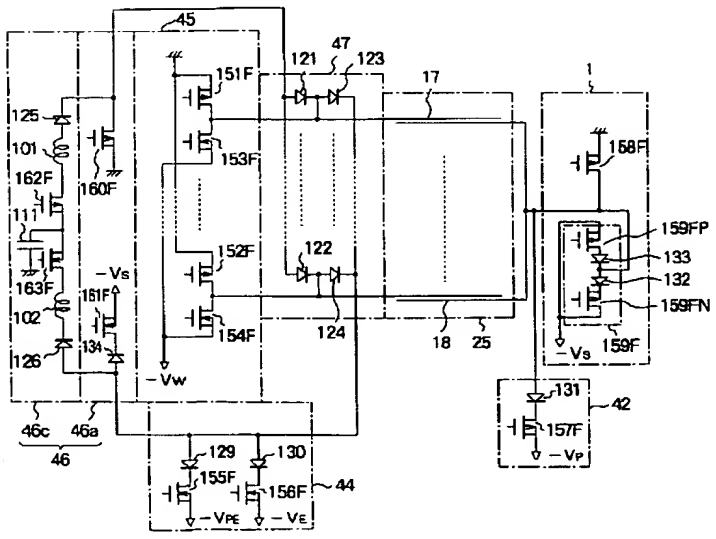
【図１】



【図２】

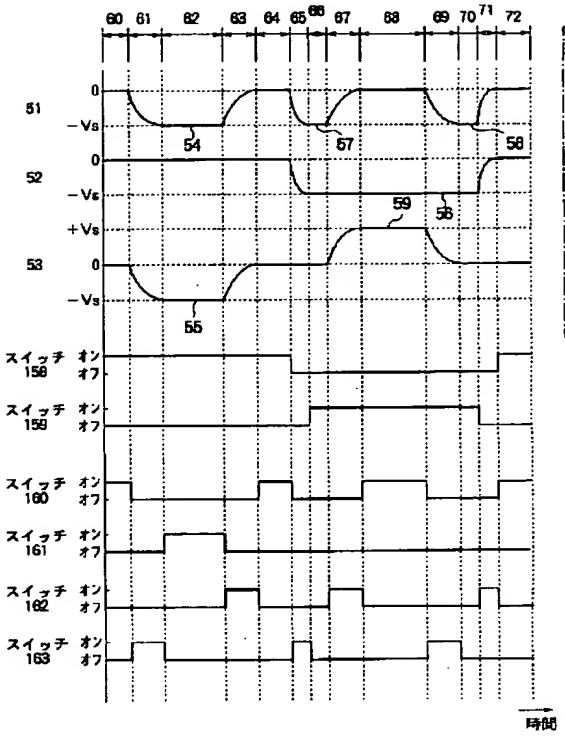


【図４】

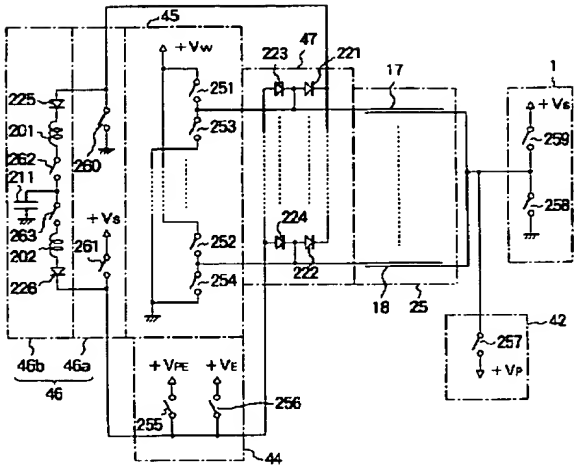


【図５】

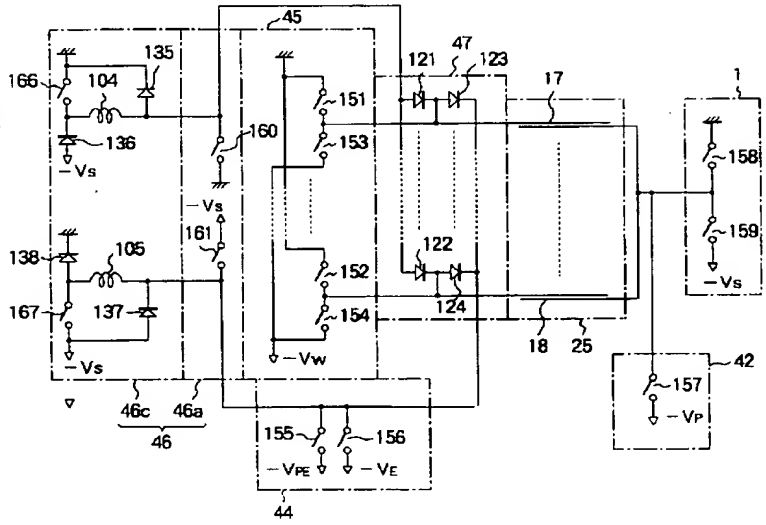
【図３】


60 61 62 63 64 65 66 67 68 69 70 71 72
51
52
53
0
−Vs
+Vs
54
55
56
57
58
59
スイッチ 158 オン オフ
スイッチ 159 オン オフ
スイッチ 160 オン オフ
スイッチ 161 オン オフ
スイッチ 162 オン オフ
スイッチ 163 オン オフ
時間

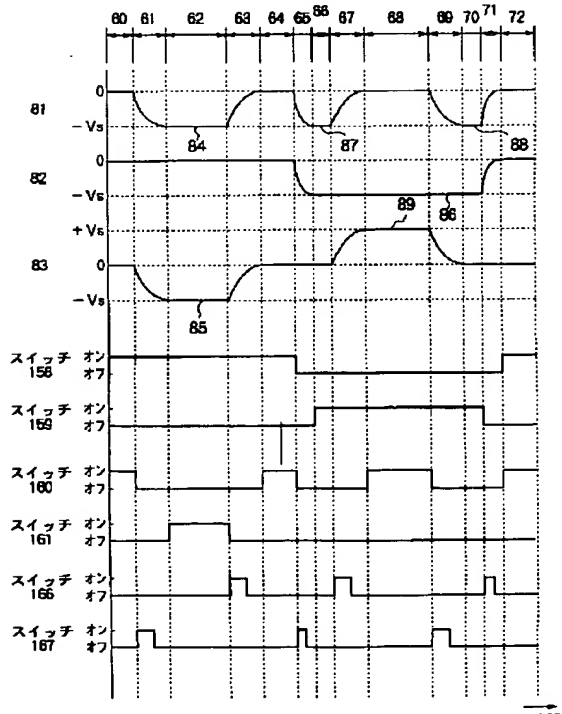
【図６】


45
+Vw
47
223
221
251
253
225
201
262
211
263
202
228
260
261
+Vs
252
254
224
222
17
1
259
258
18
25
42
257
+VP
46b
46a
46
+VPE
+VE
256
255
44

【図７】


45
135
166
104
136
−Vs
160
161
138
105
167
137
47
121
123
151
153
152
154
122
124
−Vw
17
1
158
159
−Vs
18
25
42
157
−VP
46c
46a
46
155
156
−VPE
−VE
44

【図８】


60 61 62 63 64 65 66 67 68 69 70 71 72
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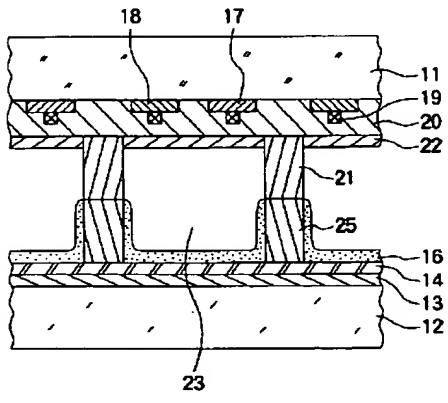
82
83
0
−Vs
+Vs
84
85
86
87
88
89
スイッチ 158 オン オフ
スイッチ 159 オン オフ
スイッチ 160 オン オフ
スイッチ 161 オン オフ
スイッチ 166 オン オフ
スイッチ 167 オン オフ
時間

【図９】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19
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21
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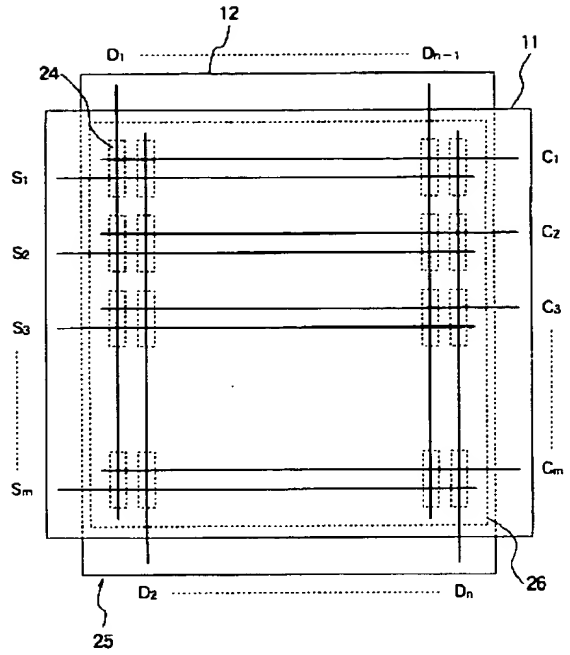
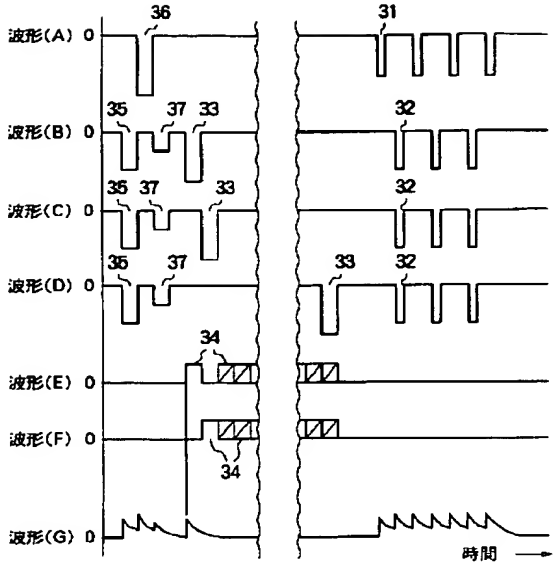
16
14
13
12
23

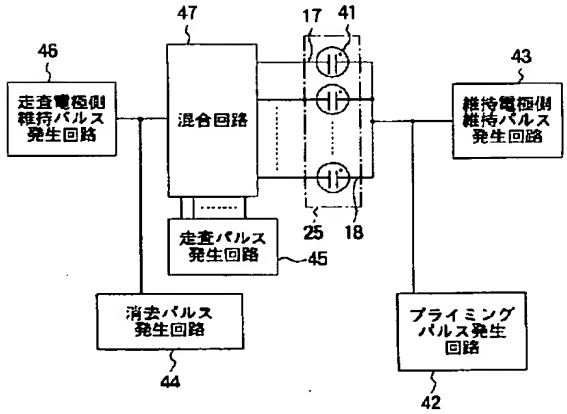
【図１０】


12
D1
Dn−1
11
24
C1
C2
C3
Cm
S1
S2
S3
Sm
D2
Dn
26
25

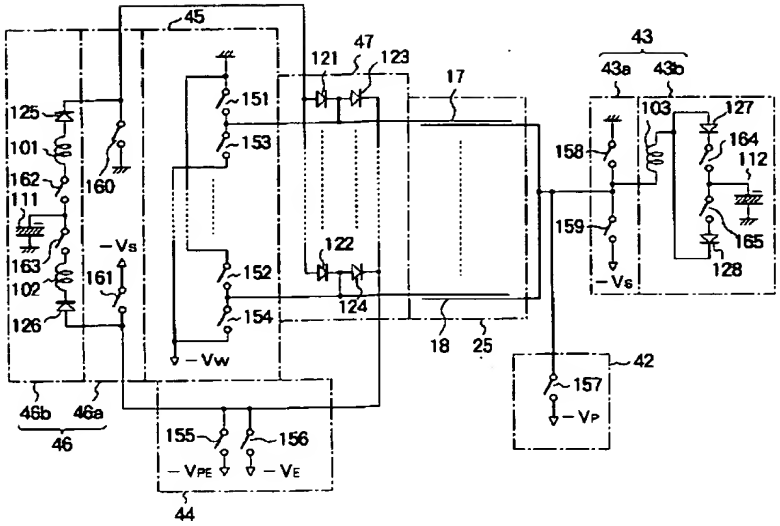
【図１１】


波形(A) 0
波形(B) 0
波形(C) 0
波形(D) 0
波形(E) 0
波形(F) 0
波形(G) 0
36
31
35
37
33
32
34
時間

【図１２】


47
17
41
46
43
走査電極側
維持パルス
発生回路
混合回路
維持電極側
維持パルス
発生回路
25
18
走査パルス
発生回路
45
消去パルス
発生回路
44
プライミング
パルス発生
回路
42

【図１３】


45
47
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123
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43
43a
43b
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111
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151
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103
127
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158
159
163
102
126
161
−Vs
152
154
122
124
165
128
−Vw
18
25
42
157
−VP
46b
46a
46
155
156
−VPE
−VE
44